SCIENCE

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IDEALS OF MEDICAL EDUCATION.[1]

WHEN the medical faculty of an ancient, famous, and progressive university honors a physician by a request that he will deliver an address to it, and to its friends, upon such an occasion as this, the subject of that address must be sought within certain limits. It should have some relation to the special work of the faculty,—to medical education as it was, or is, or should be. The fact that you have already had three addresses bearing on this subject by distinguished medical teachers, who are more familiar with its practical bearings and needs than I can be, does not authorize me to try another field, although it greatly increases my difficulty in selecting reflections and suggestions which are suited to the occasion and to the audience, and which, at the same time, will not be a wearisome repetition of what is already familiar to you. I know, however, that discourses of this kind are soon forgotten: were it otherwise, this would indeed be a hard world for address givers.

Of course the medical department of Yale is organized in the best possible manner, and is doing the best possible work, under the circumstances. I do not know precisely what its organization is, or work it is doing, or the exact circumstances which govern it, but I have no doubt it is safe to assume this. There is one circumstance, however, which very commonly affects medical schools and universities, and which therefore may possibly affect you, and that is, the want of means to do every thing that anybody may consider desirable. Perhaps, then, some remarks upon certain modern ideals of medical education, and upon first-class medical schools and their cost, based upon data derived from other schools, may be of some interest, especially in the light of Rouchefoucauld's aphorism that there is something in the misfortunes of our best friends which is not displeasing to us.

The great mass of the public — the majority of the voters of all parties, and of the women who are not voters — know little and care less about the details of professional education, or about the standard of qualification attained to by those to whom they intrust more or less of the care of their souls, their property, or their bodies. The popular feeling is that in a free country every one should have the right to follow any occupation he likes, and employ for any purpose any one whom he selects, and that each party must take the consequences.

It is noteworthy, however, that each individual professing to hold this opinion almost always makes an exception to his own occupation if it is one involving skilled labor. He is in favor of free trade in the abstract, and of limitations with regard to his own particular trade, either as to number of apprentices, as to time of study, or as to some form of trust which will prevent, as far as possible, competition in that special business. In one of its aspects, medicine is a trade, carried on for the purpose of making money in order to support the physician and his family; and to the majority of practitioners this is a very important aspect, although to very few of them is it the only one. Hence it is that medical faculties must consider schemes of medical education from this point of view also; not exclusively so by any means, but, nevertheless, with reference to the questions: What do we propose to offer? How much will it cost us? How much shall we charge for it? With reference to the first question, it is obvious that there are several quite different kinds of education which a medical faculty may offer to its students. It is by no means easy to decide as to the quality and quantity of the article offered by consulting only the advertisements, circulars, and prospectuses of the one hundred and more medical schools in the United States, but even from these it can be seen that one can get a diploma of doctor of medicine in much less time, and at much less expense, from some schools than from others, — and we all know that the diplomas of these different schools are guarantees of very different education and qualifications.

There are also several different ideals as to what is desirable in medical education. For instance, there is the ideal of the literary man, of the clergyman, of the laborer, and of other classes of the general public. There is the ideal of the man who wants to obtain a medical degree as soon and as cheaply as possible, in order that he may commence practice; the ideal of the same man after he has obtained such a degree and has been for two or three years trying to get practice; and the ideal of the middle-aged successful practitioner who has learned several things by experience since he graduated. Then we have the ideal of the army and navy examining boards, the ideal of the man of means who wants to become a specialist without ever going into general practice, and the ideal of the man who wishes to be an investigator and a teacher, either from the love of science or from the desire for fame. Let us consider these ideals briefly. The chief demand of the great mass of the non-professional public is for general practitioners, and the qualifications which these should possess may be summed up in the statement that they should be competent to recognize the forms of disease and injury which are common in the community in which they practice, and should know, and be able to apply, the remedies which are most frequently used and found efficacious in such cases. They are expected, for the most part, to follow and not to lead. It is not necessary that they should be skilled in the refinements of modern pathology, or be thoroughly trained in minute anatomy or experimental physiology, or be great surgeons, or be well up in all the specialties. Observe that I say it is not *necessary;* it may be desirable, but in the majority of cases it is not practicable.

In their brief journey of life through this world the great majority of people must travel on the routes and by the vehicles provided for them by others, and, fortunately, they are usually content to do so. They move in groups which are "personally conducted," see the things they are told to see, try with more or less success to admire the things which they are told to admire; and their chief discontent occurs when their conductors are either silent or give contradictory

[1] Address delivered before the Medical Faculty of Yale College, June 23, 1891, by John S. Billings, M.D. (Boston Medical and Surgical Journal.)

orders, — when it comes to the parting of the ways. Most travellers on an Atlantic steamer accept without murmuring the edict that "passengers are not allowed on the bridge."

The information which those who propose to earn their living by the general practice of medicine stand most in need of is that which will enable them to recognize the ordinary emergencies and to deal with them in the ordinary way. As students, their time, money, and zeal for study and investigation, are all usually more or less limited, and there are many things in a course which is called the "higher medical education" which are of comparatively little use to them. The clinical instruction which they can get at a school in the region of country in which they intend to practise will often be more valuable to them than that which they could get at a distant school of greater repute, simply from the difference in the class of cases presenting themselves for treatment. Good local pilots are in demand, although we have a superintendent of the coast survey. In some respects the old-fashioned system of medical apprenticeships, in which the student spent from one to three years in the office of a physician in general practice before he went to a medical school to hear lectures, was a good one for producing these general practitioners.

To learn to do such work easily and properly, one must live among the sick, learn how they look, how they talk, how they are to be talked to and handled; and must do this at close quarters, and not by looking on from the top bench of an amphitheatre, or from the outer ring of a group of thirty or forty men standing around a bed. Moreover, it is the common every-day ailments and their effects and treatment that the student wants to become familiar with at first, rather than the rare cases. Cases of colic, of effects of over-eating or drinking, of sore throats, croup or diphtheria, or scarlet-fever or mumps, of the ordinary fevers, of simple fractures and dislocations, of bad cuts of the palm of the hand, are far more important to him from a business point of view than brain tumors or ligations of the innominate artery.

And these comparatively simple, every-day cases are just what the young man reading in the office of his preceptor may become familiar with. How many of the men without such experience, who graduate this year at our great medical schools, have ever seen closely a case of measles, or scarlet-fever, or incipient small-pox; or have actually looked into the throat of a child suffering from diphtheria, or have ever assisted in adjusting and dressing a fractured thigh-bone, or in getting the clothing off from a case of extensive burn or scald? I have no doubt most of them could repeat the description of these things which they have heard or read, but they are not as well prepared to deal with such cases in that unhesitating way which commands confidence, as is the man who has seen and touched one or two such cases in his preceptor's office, and has observed what that preceptor said and did.

On the other hand, the number of practising physicians who are qualified to act as preceptors, and who are willing to give the requisite time and attention to students, is very limited; and with any other kind of preceptor the student wastes much time, is apt to lose interest, and become idle and unfit for continuous mental interest. If the student spent his apprentice year or two years in a preceptor's office, either at the end of his first or second year's medical lectures, or after obtaining his degree, it would be much better for him; but the latter course is open to the objection that he would probably think that he knew more than his preceptor. The Scotch medical schools prefer that the year spent as an articled pupil shall come after the first two years of education in a medical school. The decision of the British Medical Council has been that a five years' course of study shall be compulsory, and that the last year shall be spent in practical work.

Theoretically there is still a considerable amount of preliminary reading with a preceptor done in this country, but practically this method of beginning the study of medicine is fast disappearing. Through the kindness of the officers of some of our large medical schools I have obtained some data on this point, from which I infer that in the Eastern schools the proportion of students who claim to have read with a preceptor for one year before commencing lectures is from 1.5 to 30 per cent, and in Western and Southern schools from 25 to 60 per cent; but no doubt such reading in the majority of cases was merely nominal, and the student had seen little or nothing of practice. In most schools the certificate of the preceptor is not required.

The ideal of the average student who is in a hurry to begin practice needs no special decription. What he wants is to pass the examinations with the least possible labor, — the less he is compelled to take for his money the better he is pleased. The ideal of the majority of the medical profession as to what should be the minimum course of study for the degree of doctor of medicine appears to be that the student should first obtain at least such preliminary education as is furnished by our ordinary high schools, and then should study medicine four years, the first of which may be with a preceptor, and three of which are to be occupied in attending a graded course of lectures, the last two years being largely devoted to clinical and hospital instruction. About one-third of our medical schools have expressed their intention of carrying out this programme. As regards the time, it is not sufficient, according to European standards, but it is perhaps the best general standard which can be fixed at present for the education of the general practitioner for this country. Its success depends upon whether the student has had the needed preliminary education. It is the want of this last which is the chief deficiency.

The ideal of the army and navy examining boards is that a surgeon in the government service should have received either the literary, classical, and mathematical training of the ordinary college course for the degree of bachelor of arts, or the training leading to a degree in scientific studies; and that, after that, he should have spent five years in medical studies, the last year as resident in a hospital.

This ideal cannot yet be enforced in either service, for the reason that they could not get enough men who come up to this standard to fill the vacancies, so that the actual standard is somewhat lower than this, although it is higher than the minimum standard of any medical school or of any State board of examiners. Through the courtesy of the surgeon-generals of the army and navy, I am able to give you the following results of the work of their examining boards for the last ten years: —

Before the army boards, 348 candidates presented themselves during this period, of whom 76, or 22.3 per cent, were approved and passed; 31 were rejected for physical disqualifications; 90 failed to pass the preliminary examination; and the remainder failed to pass the medical examination. The rejections for physical defects are for the last three years only.

Before the navy boards, 237 candidates presented themselves, of whom 55, or 23.1 per cent, were approved and passed;

75 were rejected for physical disqualifications; and the remainder either withdrew or failed to pass.

Evidently the standards of the two boards are about the same. The proportion of those rejected for physical defects is noteworthy. In a general way we may say that about one-fourth of the candidates before such boards are approved, and one-fourth fail on the preliminary examination as to general education. Putting aside those rejected for physical causes, and making the necessary corrections for a certain number who came before the boards more than once, we find that of 429 examined, 129, or 30.2 per cent, were successful.

Of those candidates who had a college degree, 34 per cent succeeded, and of those who had no such degree, 28.9 succeeded. Of those candidates who had had one year's residence in hospital, 40 per cent passed, while of those who had not been residents, only 21 per cent were successful. The percentage of successful candidates from different schools varies greatly, ranging from 9 to 56 per cent, for those schools from which more than ten candidates presented themselves. I cannot go into details on this point, but may say that taking the medical schools of Harvard, Yale, the College of Physicians and Bellevue Hospital of New York, the University of Pennsylvania, and the University of Virginia together, of 141 candidates, 65, or 46.1 per cent, succeeded; while for all the rest of the schools in a body, of 586 candidates, 64, or 22.3 per cent, succeeded.

The figures from Yale alone are too small to draw accurate conclusions from, but in strict confidence I will tell you that of the five graduates of the Yale Medical School, who came before the army and navy boards during the last ten years, three, or 60 per cent, have passed. The greatest percentage of successful candidates comes from those who were between 24 and 25 years of age when they graduated, being 31.7 per cent, as against 27.9 per cent for those who were under 22, and 26.2 per cent for those who were over 25 on graduation.

Admitting it to be a fact that different schools have different minimum standards for graduating doctors of medicine, to what extent are these differences necessary or desirable? There is at present a very general demand that those schools which have the lower standards shall raise them to the ideal of the medical profession just stated. It seems as if the supply of physicians is now, in most parts of the country, in excess of the demand, the number of medical men being from two to three times as great amongst us, in proportion to the population, as it is in France or Germany, while the annual number of graduates also greatly exceeds the number of places to be filled.

Under these circumstances, there is necessarily a struggle for existence, in which the men of inferior qualifications usually, though not always, fail. The schools, however, will not shape their course so much with reference to the real or supposed interests of the profession or of the public, as with reference to the demands of their immediate customers, the students, and many of these, as has been said, do not want any more education than is absolutely necessary to enable them to begin practice. The ability and inclination to pay for professional services differs greatly in different localities and among different classes of people. Attempts to enforce a minimum standard of qualifications, by prescribing a minimum time for the course, and a minimum for the number of lectures in certain specified branches, will not result in fixing a uniform minimum standard of results obtained, for this can only be assured and maintained by some system of inspection and testing of results which is independent of the schools or, at all events, of each individual school. When, as Professor Sumner says, "A and B put their heads together to see what C ought to be made to do for D," there is small prospect of result so long as C is free to do as he likes.

In the Russian myth, when the raven brought the water of life and the water of death to the gray wolf, the first thing that the wolf did was to test their powers on the raven himself, to determine whether his task was properly done. The public do not have an opportunity of seeing the effect of such a test as this upon those who come to them from the schools professing to have obtained the knowledge of healing: if they had, the complaints of overcrowding in the profession would probably cease.

From the commercial point of view it seems plain that there are too many medical schools in this country, that the education which many of them are giving is a very poor one, and that the students who are attracted to these last by offers of a cheap and short course waste their time and their money.

The only really efficient remedy for this state of affairs is a system of State examinations, with minimum standards. This also has its evils, since it must lead to cramming; but it is the best we can do at present. It is urged by some that this minimum standard should be uniform throughout the United States, but in that case, it would be unnecessarily low in some parts of the country. The precise nature of the requirements in different regions depends on the density of population, and on the ability of the great mass of the people to pay enough to induce highly educated physicians to settle among them. It would be better if it were otherwise, and if every one could have the benefit of the best professional skill; but matters are adjusted in this world largely by conflict of interests. Certainly no one who intends to practise medicine should be content with the least amount of knowledge which will enable him to pass the required examinations, whatever the standard of those examinations may be.

Putting aside now this matter of a minimum standard, let us consider briefly an ideal of a medical education of a higher type. In addition to the incipient family practitioner of ordinary qualifications, the beginners in the profession, there is need of, and employment for, highly skilled, thoroughly trained physicians and surgeons as family physicians, as consultants, as specialists, and as investigators and teachers.

There are two ways in which these needed men may be educated and developed. The first is by their commencing with the ordinary course of instruction for general practice in the manner just spoken of, and then going on, after graduation and commencing practice, to study and perfect themselves in details, according to individual tastes and opportunities; and this has been the course pursued by a large number of our most distinguished American consultants and specialists. The other is to lay a broad and sound foundation of preliminary education before giving any attention to clinical study or practice. This means an education at least equivalent to that required of candidates for the degree of bachelor of arts from our leading universities, including Latin, French, and German, and mathematics to include trigonometry, and the elements of analytics. It should also include one year's work in a physical laboratory, two years' work in chemistry, two years' work in biology, at least one year's work in practical anatomy, and one year's course in materia medica.

In other words, it requires that the youth of sixteen, having obtained a good high-school education, shall go on to spend at least five years in additional study before he commences to see any thing of practice. He should then spend at least three years more in special medical and clinical studies, during one year of which he should, if possible, reside in a hospital. If then his purpose is to become a specialist, an original investigator, and a teacher, it is desirable that he should spend two years more in clinics and laboratories devoted to his special subject, and at least half of this time should, at present, be spent abroad. These are the broad outlines of what I suppose most physicians of the present day would consider a desirable scheme of medical education for an intelligent boy with a fair amount of liking for study, good health, and sufficient means to enable him to go through with it without making undue demands upon his parents or guardians.

You will observe that there are several qualifying clauses in that last sentence. The aphorism that it does not pay to give a five-thousand-dollar education to a five-dollar boy must be constantly borne in mind in considering these questions. On the other hand, it is also to be noted that in the preparation of educational schemes it is not necessary to provide for the demands of youths of extraordinary ability and industry — for men of genus. Beds suitable for giants are not required as part of the stock of an ordinary furniture store, especially if it require giants to make them. Some cases of disease will recover without treatment, though the cure may be hastened by proper management; some will die under any treatment; the result of some depends on the treatment. It is much the same in education. Some will acquire knowledge and power without special training; others will never acquire these things under any training; but the career of many depends, to a large extent, on the training which they receive. The recent announcement of a compulsory four years' course of medical studies by Harvard and the University of Pennsylvania, soon to be followed by a similar announcement from Columbia, looks toward the ideal just indicated.

The number of those who are obtaining a college education as a preparation for medical study has increased, and will still more increase as the competition among an excessive number of physicians becomes fiercer.

From information received from some of our leading medical schools for the present year, it appears that the proportion of students who have taken preliminary degrees before commencing the study of medicine varies from fourteen to forty-three per cent in Eastern schools, from three to twelve per cent in Western schools, and from fifteen to twenty per cent in Southern schools.

Just here comes in a very difficult point. When shall general education cease and special training begin? The answer to this must depend largely on the individual, but it seems to me that the present tendency is to begin to specialize too soon. This early specialization of study and work may lead to more prompt pecuniary success, but not, I think, to so much ultimate happiness and usefulness as the longer continuance of study on broader lines. "For it is in knowledge as it is in plants," as Bacon says. "If you mean to use the plant, it is no matter for the roots; but if you mean to remove it to grow, then it is more assured to rest upon roots than slips. So the delivery of knowledge as it is now used, is of fair bodies of trees without the roots — good for the carpenter but not for the planter. But if you will have science grow, it is less matter for the shaft or body of the tree, so you look well to the taking up of the roots."

In discussions on medical education and the duties of medical schools, we are too apt to lose sight of the fact that the best that the student can do in them is to begin to learn. If he does not study much longer and harder after he graduates than he does before, he will not become a successful physician. Moreover, the great majority of men have different capacities for learning certain things at different ages. They lose receptive power as they grow older.

Permit me to use here a personal illustration, and pardon the apparent egotism of an old gentleman who refers to his youthful days. Thirty-three years ago I began the study of medicine, having obtained the degree of bachelor of arts after the usual classical course of those days. It so happens that the smattering of Latin and Greek which I obtained has been of great use to me, and I may, therefore, be a prejudiced witness; but my acquaintance with many physicians at home and abroad has led me to believe that the ordinary college course in languages, mathematics, and literature is a very good foundation for the study of medicine, and I do not sympathize with those who demand that all who are to enter on this study shall substitute scientific studies for all the Greek and a part of the Latin of the usual course. This change is good for some but not for all. I had attended lectures in physics and chemistry, but had done no laboratory work, and I could read easy French and German. Thus equipped I began to read anatomy, physiology, and the principles of medicine. Nominally I had a preceptor, but I do not think I saw him six times during the year which followed, for I was teaching school in another State. Nevertheless, he told me what books to read, and I read them. The next thing was to attend the prescribed two courses of lectures in a medical college in Cincinnati. Each course lasted about five months, and was precisely the same. There was no laboratory course, and I began to attend clinical lectures the first day of the first course. One result of this was that I had to learn chemical manipulation, the practical use of the microscope, etc., at a later period when it was much more difficult. In fact, I may say that I have been studying ever since to repair the deficiencies in my medical training, and have never been able to catch up.

Probably a large number of physicians over fifty years of age have had much the same experience, and feel that there are certain things, such as the relations of trimethyloxyethylene-ammonium hydroxide in the body, or the causation of muscular contraction by migration of labile material between the inotagmata,— the bearings and beauty of which might as well be left to younger men. Not that these things are specially difficult to understand, but they form part of a new nomenclature which in most cases it is not worth the while of the older men to learn, because it is far more difficult for them to master it than it is for their sons. One of the most comfortable and satisfactory periods of a man's life is that when he first distinctly and clearly recognizes that in certain matters he is a helpless old fogy, and that he is not expected to know anything about them.

(To be continued.)

EXPERIMENTAL POTATO FARMING.

THE question of the influence of different qualities of seed upon the earliness and productiveness of a given variety of potatoes is one that has been much discussed, and the following experimental planting was made at the Ohio Agricultural Experiment Station to test the value of three qualities of seed. The seed of lot I. was grown from a planting made in the middle of March, and harvested and stored in the cellar as they ripened. The potatoes had sprouted badly during the winter, and were a good deal shrivelled. Lot II. was from the main planting, made in the latter part of April, and dug and stored in September. The tubers were quite firm, and had sprouted but moderately. Lot III. was seed from a second crop grown in 1889 in the following way. A few hills each of several sorts, from the plat which produced the seed of lot I., were dug July 11, and the potatoes planted the same day on ground that had been cleared of early peas. These gave a light yield of tubers of even size and of very fine quality. When taken from the cellar for planting they were as firm and free from sprouts as when stored.

Three pounds of each of the above lots were cut to three-eye pieces, and planted March 18. With one exception, the sorts in lot III. were from five to eight days later than the others in coming up, while between lots I. and II. no difference could be noted.

The vines of lot III., when they came, were much stronger than the others, and in a few weeks overtook and outgrew the other lots, making a much more vigorous and heavy stand.

The date of blooming, though not varying uniformly on the whole, favors the vigorous plants of lot III. for earliness, and shows that the comparatively weak and slender plants of lot I. bloomed later, or in three cases failed to perfect any bloom.

The date at which they afforded potatoes of table quality did not vary appreciably in favor of either, but the product, both in quantity and quality, was largely in favor of lot III.

While the product of lot II. was not, in all cases, much ahead of lot I. in weight, the percentage of marketable tubers was greater, and these were of greater average size.

Summarizing the results of this trial, it seems, first, that nothing is gained in earliness by the use of second-crop seed; second, that there is a positive gain in amount of product, as well as size of tubers, over that of first-crop seed grown in the same locality; third, that firm, well-kept, unsprouted seed is better than that which is sprouted and shrivelled, giving a heavier product and of better size and quality. These inferences may not be conclusive, but seem to be fairly deducible from the above results.

Still further to test the practicability of growing the second crop of potatoes in one season, five pounds of seed of each variety in lot III., as above mentioned, were dug July 23, and planted the same day, cut in halves. These came up rather unevenly, the same fault having been noticed in the previous trial. The product was of unusually fine quality, and the yield a very good one, when it is considered that potatoes of ordinary planting were almost a failure in that section of the country.

ENTOMOLOGICAL OBSERVATIONS AND EXPERIMENTS.

THE reports of the six permanent field agents of the Division of Entomology of the Department of Agriculture are included in a bulletin just issued from the government printing office at Washington. These reports are printed in full, though they are little more than summaries of the work in general performed by each agent. Special reports upon specific subjects have from time to time been sent in by special direction, and those have been published in *Insect Life*.

Mr. Lawrence Bruner, who last year reported upon the insects injurious to young trees on tree claims, has the present season devoted much of his attention to insects affecting, or liable to affect, the sugar-beet, a crop of growing importance in Nebraska, the State in which he is located. Although but one season's collecting has been done, some sixty-four species have been observed to prey upon this crop. As is shown by the report, nearly all of these can be readily kept in subjection by the use of the kerosene emulsion or the arsenites.

Mr. D. W. Coquillett's report, from California, is mainly devoted to methods and apparatus for the destruction of scale-insects by means of fumigation. The experiments were aimed at the red scale, which is one of the most difficult to treat with washes. He describes the simplified tents and the rigging which enables them to be used rapidly, and shows the advantage of excluding the actinic rays of the light. Judging from recent California newspapers, the use of this method of fighting scale-insects is rapidly increasing, and the comparatively expensive apparatus is already owned by a large number of fruit-growers. This improved method is the legitimate outgrowth of experiments which were instituted by the department at Los Angeles in 1887, and possesses the advantage over spraying that it can hardly be done in a slovenly manner. If used at all, its effects are nearly complete.

Mr. Albert Koebele, while reporting upon a number of interesting fruit pests, notably the tent caterpillars of the Pacific slope, and a noctuid larva which destroys the buds of certain fruit trees, devotes most of his report to the description of certain tests, which Professor Riley, the government entomologist, directed him to make with different resin compounds against the grape phylloxera in the Sonoma Valley during September and October of the past year. The results have been fully as satisfactory as were anticipated, and the economy of the process is very striking, labor being practically the only expense.

Miss Mary E. Murtfeldt reports upon the insects of the season in eastern Missouri, and also gives the results of experiments which she has made with certain insecticides submitted to her from the office of Professor Riley for trial. She also presents descriptions of four *Microlepidoptera*, which are new in the *rôle* of feeders upon the apple.

Professor Herbert Osborn reports upon the insects injurious to forage-crops, meadows, and pastures in Iowa. His report last year was mainly taken up with the consideration of the leaf-hoppers, to which he gives some further consideration this year, adding some notes on locusts and crickets. He presents also a series of miscellaneous observations.

Mr. F. M. Webster of Indiana devotes his report mainly to the Hessian fly, discussing the number and development of broods, the effect of the larvæ upon plants, the effect of the weather on the development of the fall brood, and preventive measures. He also gives some notes upon three of the species of plant-lice found commonly upon wheat.

NOTES AND NEWS.

THE Rev. J. Hoskyns-Abrahall writes to *Nature* that on June 10, about 10.30 P.M., near Woodstock (England), he saw what he describes as "a beautiful phenomenon." "Suddenly," he says, "at the zenith, east of the Great Bear, shone forth a yellow globe, like Venus at her brightest. Dropping somewhat slowly, it fell obliquely southward. As it passed in its brilliant career, it lighted up its dusky path with a glorious lustre. When it had descended about half-way down toward the horizon, it burst into a sparkling host of glowing fragments, each dazzlingly shot over with all the hues of the rainbow."

— According to *Industries*, two novel modifications of sulphur have been recently discovered by Engel. The first, like that proved to exist in Wackenröder's solution, is soluble in water and very unstable. The other is crystalline, soluble in carbon disulphide and chloroform, and polymerizes slowly in the cold, and quickly at a temperature of 100° C., but, unlike prismatic sulphur, which changes on keeping into the octahedral variety, it becomes converted into the white insoluble form which commonly constitutes so large a percentage of the material known as "flowers of sulphur."

— In a new process for the manufacture of phosphorus by electricity used by the Phosphorus Company, at Wednesfield, near Wolverhampton, England, says the London *Engineer*, the raw material and coke are all fed into a specially designed furnace, reduced to vapor by electric heat, and the vapor condensed into marketable phosphorus, the elaborate chemical material hitherto needed in dealing with the raw materials before putting them into the furnace thus being dispensed with. The estimated consumption of phosphorus throughout the world is only two thousand tons yer year, used chiefly for match-making. Extensions are contemplated at Wednesfield, which will ultimately, it is anticipated, lead to the company being able to make half this quantity, at that place.

— W. J. Lincoln Adams, editor of the amateur photography department of *Outing*, says in the July number: "The preparations for the twelfth annual convention of the Photographers' Association of America, which will be held this year in Buffalo from July 14 to 17, are actively progressing, and the indications point to a large attendance. Amateurs as well as professionals are admitted both as exhibitors in the various competitions and as members, with all the privileges of the association. Application for full particulars should be made to Mr. W. A. Davis, secretary, 872 Broadway, New York."

— It seems extraordinary, says the *Illustrated American*, to observe a number of bats in the evening flying back and forth through the trees with remarkable rapidity, but without ever coming in contact with the branches or hurting themselves. Spallanzani, the Italian naturalist, placed a bat in a dark inclosure, across which were stretched a number of threads, crossing and recrossing each other. The bat flew rapidly back and forth, trying to effect its escape, but avoided the threads with as much ease as if they had not been in its way in the least. Whether this curious power was the result of a sixth and unknown sense was long a puzzle to naturalists. To decide this knotty point, Spallanzani resorted to the cruel expedient of blinding a bat, and found that it still flew among the threads without being, to all appearances, any more inconvenienced than if it still had its eyesight.

— Dr. Mueller, of Yackandandah, Victoria, has written a letter to the *Pharmaceutical Journal* in which he states that in cases of snake bite he is using a solution of nitrate of strychnine in 240 parts of water mixed with a little glycerine. Twenty minims of this solution are injected in the usual manner of a hypodermic injection, and the frequency of repetition depends upon the symptoms being more or less threatening, say from ten to twenty minutes. When all symptoms have disappeared, the first independent action of the strychnine is shown by slight muscular spasms, and then the injections must be discontinued unless after a time the snake poison re-asserts itself. The quantity of strychnine required in some cases has amounted to a grain or more within a few hours. Both poisons are thoroughly antagonistic, and no hesitation need be felt in pushing the use of the drug to quantities that would be fatal in the absence of snake poison. Out of about one hundred cases treated by this method, some of them at the point of death, there has been but one failure, and that arose from the injections being discontinued after a grain and a quarter of strychnine had been injected. Any part of the body will do for the injections, but Dr. Mueller is in the habit of making them in the neighborhood of the bitten part or directly upon it.

— At a recent meeting of the Royal Statistical Society, London, a paper was read by Mr. Noel A. Humphreys, secretary of the census office, on the results of the recent census and estimates of population in the largest English towns. The first part of the paper — of which a summary is given in *Nature* of June 18 — was devoted to the consideration of the recently issued results of the census in April last in the twenty-eight large English towns dealt with in the Registrar General's weekly returns. It was pointed out that, although the increase of population within the boundaries of these towns showed an increase of nearly a million in the last ten years, the increase was less, by considerably more than half a million (605,318), than would have been the case if the rate of increase had been the same as in the preceding ten years, 1871–81; and that the rate of movement of population showed striking variations in the different towns. The rate of increase in these twenty-eight towns, it was stated, has pretty constantly declined in recent years, and has fallen with scarcely a break during the last five intercensal periods from 24.3 per cent in 1841–51 to 11 per cent in 1881–91. The percentage of increase within the boundaries of registration in London (practically those of the county of London) declined in the same period from 21.2 to 10.4. The rate of actual decline of population in central London continues to increase, and the rate of increase of the other parts of the metropolis, including even the aggregate outer ring of suburban districts, continues to decline. Examined in detail, the provincial towns show, with few exceptions, the operation of similar laws,— actual decrease in the central portions, and marked decline in the rate of increase in the other portions, the latter being specially noticeable in those towns with comparatively restricted areas. This examination, while showing the marked general decline in the rates of increase in these towns, discloses striking variations in the rates of increase in successive census periods. Mr. Humphreys called attention to the fact that these striking changes in the rates of movement of population in the large towns interpose the greatest difficulty in estimating, even approximately, their population in intercensal periods. The estimate of population in Liverpool, based upon the rate of increase between 1871 and 1881, exceeded the recently enumerated number by more than 100,000, or by 20 per cent; while in Salford the percentage of overestimate, by the same method, was 26 per cent. Thus the recent birth-rates and death-rates in these two towns have been underestimated by no less than a fifth and a fourth, respectively. The various methods that have been at different times suggested for estimating the population of towns in intercensal years, in substitution of Dr. Farr's method, still used by the Registrar-General's department, were severally considered, and it was shown that no hypothetical method yet devised affords reasonable promise of satisfactory results. It was therefore urged that a quinquennial census could alone supply a remedy for the present difficulty, which threatens to impair the public faith in death-rates, the failure of which would most seriously hinder and imperil the health progress of the country.

— Mail advices from Australia state that an exploring expedition, under the auspices of the Geographical Society of Australia, and equipped through the liberality of Sir Thomas Elder, was ready to start from Adelaide in April. The intention is to explore some of the still unknown portions of Australia. The leader of the expedition is Mr. David Lindsay, the Australian traveller, who is well qualified for the post. The second in command is Mr. F. W. Leech of Adelaide. The other members are Mr. L. A. Wells, surveyor; Dr. F. J. Elliott, medical officer and photographer; Mr. V. Streich, geologist; and Mr. R. Helms, natural history collector; besides four other gentlemen as assistants. Forty-four camels with four Afghan drivers, and a native guide, form part of the expedition.

— At a meeting of the Royal Meteorological Society, London, on June 17, Mr. A. J Hands gave an account of a curious case of damage by lightning to a church at Needwood, Staffordshire, on April 5, 1891. The church was provided with a lightning conductor, but Mr. Hands thinks that when the lightning struck the conductor a spark passed from it to some metal which was close to it, and so caused damage to the building. Mr. W. Ellis read a paper on the mean temperature of the air at the Royal Observatory, Greenwich, as deduced from the photographic records for the forty years from 1849 to 1888, and also gave some account of the way in which, at different times, Greenwich mean temperatures have been formed. Mr. Ellis also read a paper on the comparison of thermometrical observations made in a Stevenson screen with corresponding observations made on the revolving stand at the Royal Observatory, Greenwich. From this it appears that the maximum temperature in the Stevenson screen is lower than that of the revolving stand, especially in summer, and the minimum temperature higher; while the readings of the dry and wet bulb thermometers on both the screen and the stand, as taken at stated hours, agree very closely. Mr. W. F. Stanley exhibited and described his "phonometer," which is really a new form of chronograph designed for the purpose of ascertaining the distance of a gun from observations of the flash and report of its discharge, by the difference of time that light and sound take in reaching the observer. The instrument can also be used for measuring the distance of lightning by timing the interval between the flash and the report of the thunder. A paper was also read by Mr. A. B. MacDowell, on some suggestions bearing on weather prediction.

— The agricultural experiment station at Cornell University has made a series of investigations on the loss in stable manures by exposure in open barnyards, the results of which are summarized in Bulletin No. 27 of that station. Horse manure was saved from day to day until a pile of two tons had been accumulated. Cut wheat straw was used plentifully as bedding, the relative amount of straw and manure being 3,319 pounds of excrement and 681 pounds of straw. Chemical analysis showed that one ton of this fresh manure contained nearly ten pounds of nitrogen, seven and one-half pounds of phosphoric acid, and eighteen pounds of potash, making its value $2.80, if these constituents be valued at the same rate as in commercial fertilizers. The pile of manure thus made was put in a place exposed to the weather, and where the drainage was so good that all the water not absorbed by the manure ran through and off at once. It remained exposed from April 25 to Sept. 22, 1890, at which time it was carefully scraped up, weighed, and a sample taken for analysis. It was found that the 4,000 pounds had shrunk to 1,730 pounds during the five months, and analysis showed that this 1,730 was less valuable, pound for pound, than the original lot of manure. It had not only lost by leaching, but by heating or "fire fanging" during periods of dry weather, and the value of the pile of 4,000 pounds had shrunk from $5.60 to $2.12, a loss of 62 per cent. In summing up the results of this experiment, Director Roberts says: "It seems safe to say that under the ordinary conditions of piling and exposure, the loss of fertilizing materials during the course of the summer is not likely to be much below fifty per cent of the original value of the manure." Further experiments showed that the liquid manure from a cow is worth as much per day as the solid manure, and that the combined value of the two is nearly ten cents per day, if valued at the same rate as commercial fertilizers; that from a horse is valued at seven cents per day, that from a sheep at one and one-half-cents, and that from a hog at one-half cent. Director Roberts is careful to explain that these values will have to be modified to suit individual circumstances. What he means is, that, if farmers can afford to buy commercial fertilizers at current prices, then the manures of the farm are worth the prices given. The bulletin closes with plans illustrating a cheap manure shed, under which manure may be saved with practically no loss.

— Considerable progress is being made by the government of Japan in its survey operations, as we learn from the *Proceedings of the Royal Geographical Society* for June. A map on the scale of 1:200,000 was commenced sixteen years ago, and is now published (in seventy-seven sheets) for the whole of the islands except Yezo. This is, however, considered merely as a provisional publication, being based on Japanese methods of work, and therefore not to be relied on for accuracy. A modern survey was commenced eleven years ago, with triangulation of four orders, and depending on some five base-lines. Copper-plate, photogravure, and lithography are employed in the reproduction of these maps, and few if any Europeans are employed. The work appears to be excellent. Only a small proportion is completed, and it will be many years before the whole is finished. About three hundred of the published sheets can now be bought: the scale is 1:20,000. A map on a scale of 1:100,000 is also being prepared, based on the 1:20,000 map, but no sheets are yet for sale. The names on these maps are in Japanese characters. In the Geological Survey of Japan reconnaissance map, Roman characters are used, and 1:400,000 is the scale.

— At a meeting of the Geographical Society of Paris, on March 20, the Minister of Public Instruction communicated a report by MM. Rousson and Willems upon their scientific mission to Tierra del Fuego, a condensed translation of which appears in the *Proceedings of the Royal Geographical Society* for June. The region explored by them is comprised within 52° 30′ and 53° 30′ south latitude, and 68° 15′ and 70° 30′ west longtitude. This part of the country is traversed by a chain of mountains running from Cape Bogueron, where it rises abruptly to over 1,650 feet, to Cape Espiritu-Santo. Great lagoons, forming small rivers, extend into the immense plains. The watercourses are very numerous, but many of them are dried up in summer. The Rio del Oro, which is the most important stream of the northern part of the island, empties itself into the Bay of Felipe. The climate is very variable, according to the locality. The travellers did not suffer from cold at all during their journeys, but two men were frozen to death at Porvenir. The climate, however, is not so rigorous as supposed. The lowest temperature recorded by the travellers was 43°. F., and the maximum 69°, the nights being always very cold. Winds are very frequent, the most violent being those from the west, which attain a velocity of seventy miles an hour. During the three most rigorous months of the year, only six days of rain and two of snow were registered, but on the higher hills much more snow fell. The winter was stated by the natives to have been exceptionally mild. The Indians inhabiting the north of the island are the Onas. They are very tall, and sometimes attain over six and a half feet in height. Their skin is copper-colored and oily; their face is oval, forehead narrow, and their long hair falls down over their shoulders. Their eyes are small, and eyebrows well defined; nose slightly aquiline, cheek-bones prominent, mouth very large, with small yellowish teeth. They are very muscular and strong, and are great warriors, being continually in conflict with the Indians of the west and south. It is an error to suppose that they are cannibals, or that they burn their corpses. Several places were found where the Indians had buried their dead. They believe in a spirit whom they call "Waliche," and to whom they refer all good and evil. The north of Tierra del Fuego is completely destitute of trees. The only shrubs found there are the calafate, the romorille, and the mata-nigra. Quadrupeds are few, but birds of all kinds plentiful. Magnetic iron can be obtained in all parts in great quantity, and gold is also found at some points, but often at very great depths. The native population of the north may be estimated at not more than three hundred. The whole mainland north of the Straits of Magellan, which ten or twelve years ago was unoccupied, has in recent years become covered with small farms, where sheep and horned cattle are reared, and these farms have prospered to such an extent that the vast region they occupy is even now too small. The cordillera of the Andes bars any extension towards Chili, so that it may be concluded that the archipelago of Tierra del Fuego will, in the near future, receive the overflow of Patagonia. There is already on the island a model farm where nearly twenty thousand sheep and over sixty thousand horned cattle are reared.

— "I have never expressed any opinion to my professional brethren on the fundamental value of Koch's method, simply because I do not know how such an opinion can be formulated," said Professor Virchow recently in the Prussian House of Deputies, during a debate on granting additional funds for the Koch Institute. "I have only communicated a series of personal observations," he continued, "which have indeed been of service in directing attention to one part of the question, and have especially enforced the need for calm and objective study that is so requisite in these difficult subjects. Dr. Graf [a previous speaker] is still steeped in optimism. He has no right to speak of the importance of the matter until he has proved it, and it is, in fact, not proved. But it would be just as foolish if we, as pessimists, were to say, 'The matter is of no importance whatever; it is only a poison, a noxious substance.' The question has, in fact, been developed in unexpected directions, leading in many quarters to the hope that very striking results can be produced by these powerful measures — a hope we cannot yet say has been annihilated. As a matter of fact, there is not a single case known in which any form of tuberculosis has been cured by this means. All cases which were for a while regarded as cured have afterward been found to relapse. The improvements were merely temporary, such as often occur under other treatment. On the other hand, there is no doubt whatever that many serious dangers have been revealed, with regard to which I may claim some merit for myself. Nevertheless, from what I have just said, no doctor who feels called upon to make further trial of the remedy could by any possibility lay himself open to prosecution. The original trials were, in point of fact, made after results had been obtained in animals which seemed to justify the expectations that were raised regarding the discovery."

— Theo. B. Comstock, late of the Geological Survey of Texas, is now director of the University of Arizona, at Tucson.

— Professor A. T. Wood, formerly of the University of Illinois, has accepted a position as professor of mechanical engineering in the Washington University, St. Louis, Mo.

— Dr. John I. Northrop of Columbia College has died as the result of burns received June 25. Dr. Northrop, with two assistants, had gone down in the cellar of one of the buildings to supervise the placing of some newly acquired specimens in alcohol, when an explosion occurred and all three were severely burned. Dr. Northrop was about thirty years old and was highly esteemed.

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THE MOA IN AUSTRALIA.[1]

RECENT discovery in Lord Howe's Island has proved that post-tertiary Australia extended far to the east of its present shores. Still it remains true that if among the results of inquiry into the past phases of Australian life there be one suggestive of the possible inter-relation of faunas apparently as distinct in history as in location, it is the discovery of a bird identical with the moas of New Zealand, and of others so near akin to them as to have been pardonably mistaken for them by acute observers. Fossils so like moa bones as the latter must necessarily have been, clearly show that the evolution of these grand birds was not initiated in their recent island home, but that it had already made considerable progress in that portion of a far-reaching continent which we now name Australia, when a period was put to the Nototherian age by desolating outflows of lava over the greater part of the land. Having regard to the improbability of birds so organized effecting a passage over sea under any ordinary circumstances, we can hardly escape the further conclusion that New Zealand's entire separation from the continental area was brought about in time not more remote than that era of intense volcanic activity. One is even tempted to surmise, and it appears very possible to do so without absurdity, that it was one among the consequences of that very manifestation of energy. But this is an instance of speaking without book on a question which should be rigorously, as it may be confidently, left for decision in the hands of New Zealand geologists. Cumulative evidence to the same effect, but still more explicit in kind, is yielded by a relic of a true dinornis. From it we gather that the process of evolution had, in the self-same place and time, accomplished more than we could have justly anticipated without such warrant — the production of that more complete departure from the rest of the *Struthionidæ* which we recognize in the moa type. And again, as the "wolves" and "devils" of Tasmania, the "crowned pigeons" of New Guinea, and the "wallabies" of those and other Pacific islands, have been cut off from the common ancestral seat of their genera, so also have the moas.

It is indeed somewhat strange that the notion of the same genus of birds existing at one time in Australia and at a later period in New Zealand should ever have been thought inadmissible, yet it is difficult to see what other conception of the case should have been in the mind of Sir Richard Owen when he spoke of the advent of an Australian moa as "an exceptional extension of a New Zealand genus to Australia." At the same time it is by no means to be regretted that Owen did take this view, and that in consequence he regarded with suspicion any Australian claim to moa rank, however well accredited. It is to the stimulation of his critical faculty by incredulity that we owe the full assurance that there has existed a bird which, though not dinornis, had much in it pertaining to dinornis, a degree of affinity which under the circumstances could not have been overstated, but, as stated, is quite sufficient to show that Australia was the nursery of the sept.

But let us quit generalities for the more immediate object in hand, viz., a brief review of the recorded occurrences of the moa stock in Australian deposits. As if to excite a hope that such occurrences would be frequent, the first of all the extinct birds of Australia to be drawn from those deposits and made known to science was a struthious bird dwarfing in size not only existing cassowaries and emus, but the emu which was contemporary with it. A thigh-bone of this bird was discovered in the year 1836 by Sir Thomas Mitchell in a brecchia cave in Wellington Valley, New South Wales. It was examined by Sir Richard Owen, and figured by him in an appendix to Mitchell's "Three Expeditions into the Interior of Eastern Australia," 1838. At that time, as we are subsequently informed, Owen determined the bone "to belong to a large bird, probably from its size struthious or brevipennate, but not presenting in its femur characters which justified him in suggesting closer affinities." The study of moa bones in after years enable him, he says, to perceive that in some features of importance the cave femur "resembles that bone in the emu rather than in dinornis." We learn further that "the length of this fossil was 13 inches, the breadth of the middle of the shaft not quite 3 inches," — measurements which are noteworthy, as they render it apparent that in its dilated proportions the bone was much more like the dinornis femur than that of the emu, which has a breadth of only 1¼ inches to a length of 8¾ inches.

Thirty-three years elapsed before any further light was thrown upon a problem which was sufficiently obscure. It then issued from the Peak Downs, near the centre of Queensland, where in 1869 a well was being sunk. The workmen passed through thirty feet of the residuum of basaltic decomposition, the "black soil" characteristic of "downs" country, then through 150 feet of drift pebbles and bowlders. Lying on one of the bowlders, at 180 feet from the surface, they met with a short thick femur, which was happily preserved from the usual fate experienced by such finds, and, more happily, passed into the hands of the well-known geologist, the Rev. W. B. Clarke. In concert with Mr. G. Krefft, then curator of the Australian Museum, Mr. Clarke compared it with the moa bones, with the result that he felt himself justified in announcing the discovery in the *Geological Magazine* of that year in a letter entitled, "Dinornis an Australian Genus." At Sir R. Owen's solicitation a cast of this bone was sent to him by the trustees of the Australian Museum, and this, in 1872, formed the subject of a communication from Owen to the Geographical Society. After pointing out at length the characters in which this femur resembles dinornis and dromæus (emu) respectively, the examiner decides "that in its essential characters it resembles more that bone in the emu than in the moa, and that the characters in which it more resembles dinornis are concomitant with and related to the more general strength and robustness of the bone, from which we may infer that the species manifested dinornithic strength and proportions of the hind limbs combined with characters of closer affinity to the existing more slender limbed and swifter wingless bird peculiar to the Australian continent." To the bird represented by the fossil Owen gave the name "dromornis," a name significant of his conception of the paramount affinity displayed by its femur. If with that judgment a succeeding observer finds it impossible to completely harmonize his own conclusion, and says so, it is because in this case compulsion rides rough-shod over peril. That the dromornis bone has important features which relate it to the emu rather than to the moa is a position which is unassailable, but that these alone are its "essential" characters is a postulate, and one that has no right to command assent. Essential they are among the dromæan features of the bone; but of the compound dromornis bone as a whole they form but a part of the essentials. The absence of the air-duct communicating with the interior of the bone, a characteristic dinornithic feature, seems quite as important as a structural index to habit as the dromæan set of the head of the bone; and, being strictly dinorthic, it is not "related to the general strength

[1] By C. W. De Vis, M.A., in the New Zealand Journal of Science for May, 1891.

and robustness of the bone," but to its comparative solidity. Again, the "dinornithic strength and proportions of the hind-limbs" is a reminder which should carry more weight than it was probably intended to bear, but is nevertheless but a partial statement of the fact, for it leaves out of consideration the great difference in the relative proportions of the bone under examination. It is not that the bone is altogether larger or smaller in the same ratios of length and breadth, but in different ratios, the dromornis and dinornis ratio being much the same. The dromornis femur is but one-third longer than that of the emu, yet its shaft is twice as thick transversely, and its upper end is more than twice as broad. With such bones the bird would probably have the general appearance, the gait, and habits of a moa rather than those of an emu. In short, dromornis exhibits at the least an intermediate form between the moa and the emu, probably a nearer approximation to the former than to the latter.

After another interval of fifteen years a third dinornithic bone was picked up in King's Creek, on the Darling Downs, by Mr. Daniels, and by him presented, with other contemporaneous fossils, to the Queensland Museum. This again presents the upper end of a thigh-bone, but minus the upper part of the great trochanter, which appears to have been shorn off by the abrading action of drift sand while the bone projected from the bed of a watercourse; in other respects it is in excellent preservation. Repeated comparison of this bone with species of dinornis, with dromornis, casuarius, dromæus, struthio, and rhea, has removed from the mind of its describer all doubt of the former existence of the typical moa in Australia. To him it appears to resemble as closely any one of the femurs from New Zealand as any two of these, specifically different, resemble each other, a view which of course implies the absence from it of features notably present in the emu bone. The most important of these is one to which reference has already been made. The "head" of the bone, or that hemispherical projection which fits into the corresponding cavity of the hip-bone, stands out prominently in the moas, in consequence of the neck behind it being somewhat long and of considerably diminished diameter; whereas in the emu the neck is short and thick, so that the limits of the head, especially on its upper surface, are less distinguishable. In this feature, easier to recognize by inspection than by description, dromornis agrees with the emu, while the Queensland moa exhibits the comparatively slender neck and well-defined head of its New Zealand successors. It is not necessary at this moment to insist upon the value of the several characters which aid in the generic identification of this bone with dinornis; they are to be found by any one sufficiently interested in the matter in the "Proceedings" of the Royal Society of Queensland for 1884. To others a recapitulation of them would be tedious.

Unfortunately the identification has not yet been supported by further testimony, a circumstance which can hardly be thought surprising when the extreme slowness with which dinornithic remains have been brought to light is borne in mind: three bones in over half a century has been the rate of discovery hitherto. Adding to these three others from which no precise information can be derived, viz., two ribs provisionally referred to dromornis, and the shaft of a femur too imperfect for determination, but certainly not dromornis, and in all probability not dinornis, all the fossils of this kind known to the writer have been mentioned. In a fairly numerous collection of bones of contemporary birds the paucity of such fossils is conspicuous, but it would hardly be safe to infer from that circumstance that the birds themselves were rare. The most we can say is that they were not among the ordinary frequenters of the lower levels in which the ossiferous drifts of the period were accumulating. It is therefore with sustained eagerness that every fresh tribute of bones is received and inspected, since the hope is always present that they may contain some further proof of the reality of the Queensland moa, as convincing to others as it would be welcome to the assertor.

Be it at the same time observed that there is no reason why a greater amount of proof should be demanded in this case than in others. There is no inherent improbability involved by it so great as to justify inordinate doubt, since the passage of dromornis into dinornis is not so long and difficult a matter as to require for its accomplishment a new home and a geological remove. The only objection to be raised against it is that it confirms and accentuates the antecedent difficulty created by dromornis itself,—the difficulty of accounting for the presence of moas in New Zealand under their lately existing circumstances. It is not a mystery that they should have been there at all, since it is anything but incredible that a subsidence of ten or twelve thousand feet should — during a geological age which has seen the whole Australian fauna profoundly changed — have taken place in an area liable to volcanic disturbance, such as we see effects of in Australia and feel the throes of in New Zealand. Before that subsidence, Mount Cook, from a height about equal to the Cordilleran peak of elevation, Aconcagua, would have looked down and over continuous land as far as the snow-capped mountains of Queensland, the view unhindered by the intervening peak of Lord Howe's Island,— the refuge of Meiolanian reptiles once in communication with their kinsfolk in Australia. The true difficulty is not the isolation of New Zealand from Australia, but the strange isolation of the moas from all other forms peculiar to Australian life. Why should their stock alone have escaped to an eminence of the sinking surface, or alone been introduced into the insulated land, or alone survived some change in its life-conditions fatal to the rest? The moa in New Zealand is the question that calls for an explanation; and in proof that it does call for an explanation, and is not to be dismissed as a voiceless phantasy, we point to dromornis followed (structurally) by dinornis in Australia, and we wait for its solution in the work of New Zealand's naturalists.

DESTRUCTIVE LOCUSTS.

SINCE the great "grasshopper years" of 1873–76 there have been frequent outbreaks of comparatively local species, as well as a few cases in which small swarms of the Rocky Mountain locust have flown out into the subpermanent region and have occasioned some damage for a year or so. The most notable cases have been the outbreaks of the lesser migratory locust in New Hampshire in 1883 and 1889, the extraordinary multiplication of the devastating locust in California in 1885, the increase of local species in Texas in 1887, the multiplication of a chance swarm of the Rocky Mountain species in a restricted locality in Minnesota in 1888, and last year's damage in Idaho by several non-migratory species combined.

For a number of years the first and second reports of the United States Entomological Commission, which contained the results of the labors of the commission upon the Rocky Mountain locust, have been out of print, and yet with every renewed alarm caused by locusts there has been a great demand upon the entomological division of the United States agricultural department for information, which could only be supplied by correspondence or by publishing the information in local newspapers. For a time the demand was filled by supplying the annual report of the department for 1877, which contained bodily the chapters upon remedies from the first commission report. The supply of this document was also soon exhausted.

The fact that Mr. Bruner, in his last summer's trip to Idaho, investigated the latest rumors, and found that considerable damage was being done, and that the farmers were not acquainted with even the most rudimentary measures for protection and remedy, showed the necessity of publishing a condensed and practical account of the species which become seriously injurious from time to time, and of republishing in as brief form as possible the matter on remedies and preventives from the reports mentioned. The result is the publication by the government of a bulletin on "Destructive Locusts," prepared by Professor C. V. Riley, government entomologist. This bulletin is, in fact, a reproduction of matter already published but now inaccessible for dissemination, and which, from its nature, has a permanent value, together with such additional facts as subsequent experience has revealed. It contains no technical matter whatsoever, and the farmer will be able to recognize the different species from the figures which accompany the consideration of each.

The portion which relates to remedies, while drawn up for use against the Rocky Mountain locust, will apply in large part to other migratory locusts, as well as to the non-migratory species. Detailed descriptions of the various machines which were given in the original reports are, for the most part, omitted, in the belief that the figures themselves will be sufficiently suggestive for the purpose. In point of fact, many of these machines, especially the more complicated, while serviceable, cannot be recommended to the average farmer dealing with the locust plague, and experience has shown that those simple forms providing for the use of coal-oil and coal-tar are, on the whole, the most efficacious against the unfledged insects. It is, therefore, to this portion of the bulletin that Professor Riley particularly calls the attention of those needing the information contained in it. But little experience of practical value has been had since the last great invasion; hence little has been added to this section of the bulletin beyond a brief description of the trapping system used in Cyprus against the migratory locusts of the Old World, and an account of the bran-arsenic mash remedy used in California in 1885 against the devastating locust.

THE TREES OF TASMANIA.

THE government of Tasmania has recently issued a publication, the "Tasmanian Official Record," which contains much useful and interesting information concerning the trees of that island. It is peculiarly a forest country, and many of the trees are of great dimensions, towering over and eclipsing the lesser undergrowths on plains, valleys, hills, and mountain slopes. Of the 16,778,000 acres comprising the total area, there are only 75,000 acres occupied by lakes, and 488,354 acres of cultivated land only partially cleared of its timber. With the exception of minor areas on the tops of mountains or among the barren uplands of the western highlands, the whole of the rest of the country is occupied with an almost continuous virgin forest, mainly composed of the various forms of eucalypti (gum trees), one noted example of which, the Iolosa blue gum, has been recorded as measuring 330 feet high. Many of these trees have stems measuring 150 feet high without a branch, with a girth of about 40 feet towards the base; and it is also recorded that a blue gum at Southport (*Eucalyptus globulus*), the prevailing tree towards the south of the island, "contained as much timber as would fully suffice to build a 90-ton schooner."

With such a wealth of forest trees, Tasmania's sources of timber supply must be infinitely great, and in the near future must be of great industrial value; but the difficulties of transit, the ignorance of their economic value in distant markets, the plethora of local supply, and the necessity for clearing the land in the most convenient way, all tend, it is said, to produce waste and improvidence in respect of timber products, which might soon become a great source of national wealth.

The necessity for the better conservation of the natural forests in Tasmania has lately commanded the attention of the local government, and a department has been created for the purpose of establishing conserved areas, and for regulating all matters connected with the cutting of timber on government lands.

The following is a description of the more important timbers as regards their industrial value. The blue gum has its home principally in the southern parts of Tasmania, where it attains great dimensions. Many of these trees exceed a height of 280 feet, with a girth of from 40 to 50 feet. A tree called "Lady Franklin's tree," near Hobart, is stated to have a circumference of 107 feet at a height of four feet from the ground. The timber of the blue gum is of rather a pale color, hard, heavy, strong, and durable. In transverse strain its strength is about equal to English oak. It is used in house and ship building, and also by carriage builders and manufacturers of tools.

The "peppermint tree" has a wide range, as it is found in the southern and eastern humid districts of Victoria and New South Wales, as well as in Tasmania. It varies greatly with altitude, climate, and soil, and is found at all heights up to 4,000 feet elevation. In the poorer lands the trees, though tall, are not remarkably so, but in the deep wooded gullies and in the moist ravines of mountains it attains such remarkable dimensions that it has obtained the distinction of the "giant eucalyptus" of Australia. The timber of this tree is useful for many kinds of carpenters' work, as in drying it does not split. It is also used in ship-building, for keelsons and planking. Besides its timber, this tree is famous for other products of value. The ashes of the foliage yield, it is stated, ten per cent pearlash; and from one thousand pounds of fresh leaves, with their small stalks and branches, the yield of eucalyptus oil by far surpasses all that of other congeners, amounting to five hundred ounces per thousand pounds.

The stringy-bark gum is a valuable tree, found in abundance in Victoria, South Australia, and Tasmania. It is straight stemmed and of rapid growth, attaining a maximum height of 300 feet. The wood of this tree supplies a large portion of the ordinary sawn hard timber for rough building purposes. It is also well adapted for carriage, cart, and wagon building, wheelwork, and agricultural machinery, as well as for the framing of railway carriages and trucks. The white gum, or "manna tree," is abundantly distributed throughout the island, and has also a wide distribution on the mainland of Australia. Its timber is used for shingles, rails, and for rough building materials. The small branching trees on open ridges and plains are noted for exuding a sugary substance called "manna," which is esteemed a great luxury, and is eagerly sought for by the young.

The gum-topped stringy bark is held in high esteem in Tasmania, and the chief peculiarity of this tree is that, while the lower part of the butt is clothed with a thick fibrous bark, the upper part and the smaller limbs and branches are quite smooth. The timber from this tree is highly prized, and it is described by competent authorities as second only to the blue gum. The iron bark is a valuable tree attaining a height of 150 feet. The trunk is sawn into good timber, and it is also used for posts and rails.

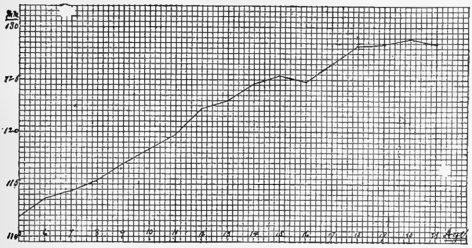
One of the most handsome of the native trees is the blackwood, which is widely distributed along the slopes of the north-west coast. It attains a height of from 60 to 130 feet. The timber is of a brownish color, closely striped with streaks of various shades of a reddish brown. The more ornamental logs of this wood are exceedingly beautiful, and fetch a high price. The myrtle or beech is common in Tasmania, and forms a large proportion of the forests. The "huon" pine is said to be the grandest and most useful of all the soft woods. It is abundant along the rivers of the south-western parts of the island, attaining a height of from 60 to 120 feet, with a diameter of three to eight feet. Its timber is almost indestructible in any situation. It is largely employed, locally, for all kinds of furniture and ornamental work, and is the most highly-esteemed of all kinds of wood for the lighter sea craft. Among the other trees of Tasmania may be mentioned the red pine, oyster bay pine, silver wattle, black wattle, and native cherry.

LETTERS TO THE EDITOR.

Growth of the Face.

DURING the past year investigations upon the physical growth of children have been conducted in the Worcester schools. The preliminary tables on the growth of the female face bring out some facts of considerable interest. There seem to be three distinct periods, the first ending about the seventh year, and the third beginning about the fifteenth year. A striking peculiarity is the seemingly abrupt transition from the types of one period to those of the succeeding. The sudden disappearance of the lower widths of face, and the equally sudden appearance of the types of the succeeding period, e.g., the sudden shooting up of the widths to almost adult dimensions at about the age of eight or nine offset by the equally sudden disappearance of the distinctively childish characteristics at the age of eleven. These peculiarities also appear at the ages of twelve and fourteen respectively in the succeeding period. This would seem to indicate the very slow growth of some children until the ages of about eight and fourteen respectively are reached, and then a very rapid development of each individual to her proper position in the series. This Axel Key found also to be true with respect to the total height of the Swedish children observed by him.

In the second period very many of the forms are already adult, and, if not at their fullest development, have very nearly approached it. From the fifth to the tenth year inclusive the growth is somewhat slow, about 6.5 millimetres in all, but for the next four years, the period of adolescence, the growth is 6.2 millimetres. From the fourteenth year on there is very little advance, the maximum seeming to be reached at about 128 millimetres in the twentieth year.



On comparing this growth with that of the male face some differences are noticeable. The male face is, with perhaps a single exception, larger for the same period of life and for the same years: it appears to grow more rapidly and continues to grow later in life. Massing the cases after twenty, the advance is seen to be far beyond the breadth attained at nineteen, rising to about 138 millimetres. At about nine years the two types approach very near, and it is not at all unlikely that, as found in the case of height by Bowditch in Boston and Peckham in Milwaukee, the female face may for a short period become the broader. Further investigations will be required to determine this point, the present investigation having been made on not more than twenty-five hundred persons, including both sexes. GERALD M. WEST.

Clark University, Worcester, Mass., June 18.

Millimetres.	Age in Years.																
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+
100–101	1																
102–103				1													
104–105	1		2	1													
106–107	2	4	2	3		2											
108–109	3	4	2	4	3	1											
110–111	6	14	9	8	6	4	4										
112–113	8	13	20	12	9	5	5	3	1	3							
114–115	9	10	16	13	14	16	12	4	4	1							
116–117		10	15	9	19	18	15	13	6	1		1					
118–119	1	5	13	18	14	25	22	14	10	6	1	1			1	1	1
120–121		1	4	8	11	23	18	14	16	9	5	2	1	1	1		2
122–123				7	3	15	19	18	13	14	8	4	1		1	3	2
124–125	1			1	4	5	14	22	20	18	9	8	2	3	4	3	5
126–127					3	3	6	11	15	15	10	3	2		4	7	5
128–129						1	5	5	4	7	9	3	2	2	6	3	3
130–131					1			4	6	5	2	1	1	4	6	3	4
132–133						1		1	3	3	1		1	1	3	2	6
134–135								2	1	3	1	1		1	1	2	5
136–137										2					2	1	
138–139								1								1	
140–141																	
142–143																1	
Totals.	32	61	82	84	86	119	115	112	99	87	46	24	10	12	29	27	33
Averages.	111.9	113.6	114.3	115.3	117.0	118.4	119.7	122.3	123.0	124.6	125.4	124.7	126.5	128.2	128.4	128.8	128.4

BOOK-REVIEWS.

The Evolution of Marriage and of the Family. By CH. LETOURNEAU. New York, Scribner. 373 p. $1.25.

AMONG the distinguished French students of sociology, Professor Letourneau has long stood in the first rank. He approaches the great study of man free from bias and shy of generalizations. To collect, scrutinize, and appraise facts is his chief business. In the volume before us he shows these qualities in an admirable degree. The subject is one of the most vital in social dynamics, for the relation of the sexes is the foundation of primitive society, and on primitive rests and grows all higher social development.

He dismisses as unfounded the extravagant views of McLennan, Lubbock, and our own countryman, Morgan, who would identify primitive marriage with sexual promiscuity. Here, as elsewhere, his opinions are based not merely on the facts of ethnography, but on numerous analogies drawn from the higher orders of the animals inferior to man: for Letourneau holds, along with all other leading ethnographers, that in the senses and emotions man reveals no other distinction above the beast than one of degree, nowhere one of kind; and to understand the motives and customs of the savage state, more is learned from the brute than from the civilized man.

His range of comparison covers all races and extends over all conditions of society. At the close of his attractive pages he ventures to forecast the future of the institution of marriage. He believes that it will be a merely civil contract, monogamous in character, easily contracted, and freely dissolved by simple mutual consent of the contracting parties. Something very near this is already the case in the more enlightened of the Swiss cantons and of the United States. The utmost facility of divorce, with proper guarantees for the interest of the parties concerned,— children and parents,— is the condition to which this work, as well as other unprejudiced studies of the marital relation, unfailingly point.

AMONG THE PUBLISHERS.

THE agitation in the religious world has now come around to the point which is treated in "An Honest Hypocrite," a novel by the Rev. E. Staats DeGrote Tompkins, published by the Cassell Publishing Co.

— G. P. Putnam's Sons have just issued "Politics and Property; or, Phronocracy," a treatise on a compromise between democracy and plutocracy, by Slack Worthington.

— Professor Lanciani contributes to the July number of the *Atlantic Monthly* a paper on "Underground Christian Rome," in which he tells of the discovery of the Christianity of an ancient Roman family from the excavation of their ancient burial place. This is followed by "The Old Rome and the New," sufficiently described in its title, by Mr. W. J. Stillman; a paper by Bradford Torrey on the "Male Ruby-Throat;" the "Story of a Long Inheritance," by William M. Davis, which, though no one would ever suspect it, is devoted to tornadoes. Mr. Nathaniel Southgate Shaler's paper on "College Examinations," which will excite remark, is among the other features of the number.

— A valuable book for all interested in the numerous applications of electricity is T. O'Conor Sloane's "Arithmetic of Electricity" (New York, Henley & Co. $1.). It is a practical treatise on electrical calculations of all kinds, reduced to a series of rules in simple form, and involving only the use of ordinary arithmetical methods. Each rule is illustrated by one or more practical problems, with a detailed solution of each one. There is also an extensive series of tables, covering pretty thoroughly the field of electrical work. It may be added, that, in addition to the arithmetical solutions of the problems, there is given after each rule, wherever practicable and useful, the usual algebraic formula.

— In the *Century* for July Professor Edward S. Holden of the Lick Observatory has a paper on popular astronomy, entitled, "A Lunar Landscape," with pictures from negatives taken at the Lick Observatory.

— In their series of introductory science text-books, Macmillan & Co. have published "An Introduction to the Study of Botany," by Edward Aveling, fellow of University College, London. The volume is intended as a guide to the study of botany, and assumes on the part of the reader no knowledge of the subject. While in its general plan the work is based on the syllabus of the science and art department at South Kensington, it cannot fail to prove helpful to all who take up the study of botany, no matter what special end they may have in view. The book has 271 illustrations, and a glossary of over six hundred words. A novel feature is that the pronunciation in English is given of every Greek work used to show the derivation of the botanical terms.

— Henry Holt & Co. will publish early in September a complete "Text-Book of Elementary Physics," chiefly experimental, by Edwin H. Hall, assistant professor of physics in Harvard College and Joseph Y. Bergen, Jun., instructor in the Boston English High School. This book will contain, among other things, the forty required experiments mentioned in the Harvard pamphlet, and cuts from photographs of some of the more novel elementary apparatus actually in use in the Harvard College physical laboratory. The same publishers also have in press an "Elementary Laboratory Physics" for high schools, by Charles R. Allen of the New Bedford High School.

— Macmillan & Co., the publishers of Mr. Joseph Pennell's "Pen Drawing and Pen Draughtsmen," will issue in July a book by the same author, descriptive of the River Thames, under the title "The Stream of Pleasure."

— Cassell Publishing Co. have ready "The Letters of Marie Bashkirtseff," which, by special arrangement with Madame Bashkirtseff, the mother of the writer, and the French publishers, are published in this country before their appearance in France. André Theuriet, the editor of the "Journal of Marie Bashkirtseff," has edited these letters also. The book is uniform in typography and binding with the "Journal," and contains new portraits of Marie, with reproductions from her sketches, besides other illustrations.

— D. C. Heath & Co., Boston, will issue very soon, "Studies in United States History," for use in grammar schools, by Mary Sheldon Barnes, author of the "Studies in General History," and Earl Barnes, professor of history in Stanford University, California.

— For the *New England Magazine* for July, Professor J. L. Ewell of Howard University, Washington, writes on "Schliemann's Discoveries in Hellas;" and William M. Salter, in "Emerson's Views on Reform," shows what a radical the Concord philosopher was, and how few of the most advanced reformers of to-day are as advanced as he was in his ideas of social comity.

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QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

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N. D. C. HODGES,
47 LAFAYETTE PLACE,
NEW YORK.

SCIENCE

NEW YORK, JULY 10, 1891.

IDEALS OF MEDICAL EDUCATION.[1]

(Continued from p. 4.)

HAVING thus roughly sketched what is wanted in the way of medical education by different classes of students, — the article for which there is a market, — let us next consider briefly what a university may wisely attempt to provide in this direction. Some suggestions on this point may perhaps be obtained from an examination of the condition of affairs as regards medical education in the University of Oxford.

The Corporation of Oxford has a little more than half the number of inhabitants possessed by the city of New Haven, and its relations to London are, in many respects, similar to those of New Haven with the cities of New York and Boston. For a number of years it has been urged by some physicians in England that the University of Oxford, with her great resources, has not been doing as much for medical education as she should have done, and that it is her duty to establish and maintain a completely organized medical school of the usual pattern, using the small local hospital and dispensary facilities for the clinical side of the work.

On the other hand, other physicians, of whom my friend Sir Henry Acland may be taken as the representative, maintain that it is much better that Oxford should use her resources in giving a broad foundation of literary and scientific culture, including, for those who propose to study medicine, the means of special instruction in general biology, and in comparative and human anatomy, physiology, and pathology; and that the men thus prepared should go to the great hospital medical schools of London to obtain their clinical training; after which they may return and pass their final examinations, and obtain the coveted degree of doctor of medicine from the university.

There is no doubt that this can be done, and that a great part of the scientific foundation of a complete medical training can be furnished by a well-equipped university, with little or no reference to clinical instruction at the same time and place. This, for example, is the course followed by many of the students in the medical department of the University of Virginia, and it seems to me that there is also no doubt that the men who go through such a course of training, followed by clinical training in a great city, will have a better course of instruction, a wider experience, and a better chance of seeing and appreciating the methods of great clinical teachers, than would those who obtained their clinical as well as their scientific training in the small town, or than those who obtain all their instruction in a school devoted exclusively to medical studies. Upon this last point I need not dwell, for Dr. Welch, in his address before you in 1888, has clearly pointed out the advantages of giving to a medical school a university atmosphere, and of making the union of the school and the university close and intimate. It should be noted, however, that the more true this is, the more it is the duty of a university to maintain such a school, because educational work which cannot be, or is not, done so well elsewhere, has superior claims upon university aid. The chief thing which can be said in favor of the attempt to attract a large number of medical students of average qualifications to an institution having the means to give the higher education are, first, that it brings in more money, and second, that it enables those professors who desire advanced workers, to select these from a somewhat wider field.

It must be confessed that nearly all our great American universities are unwilling to apply their funds to the creation and maintenance of a well-equipped medical department. They are willing to have such a department, no doubt, but they want the money for establishing and maintaining it to be provided in addition to money which has been, or is to be, provided for the general purposes of the university. The ideal university culture of the present day appears to be designed to fit a man to take pleasure in his own thoughts and musings, and in mental exercises in languages, literature, the higher mathematics, and the problems of physics and natural history. Incidentally his knowledge of these things may not only give him pleasure, but enable him to help others; but the studies are not to be pursued on account of any practical utility which they possess, but for the love of learning and pure science, that is, for personal gratification of a particular kind. Those who hold these views are apt to consider medicine as a technological matter, which should be left altogether to special schools, because, being practically useful in a commercial sense, the means of teaching it are sure to be provided through commercial interests, just as they are sure to be provided for the teaching of practical engineering. This is far from the old university idea as embodied in the three faculties and four nations of the University of Paris. So far as the interests of the public are concerned, it is only the possession and control of a large amount and variety of clinical material, or of unusually qualified clinical teachers, which makes it the positive duty to use it, or them, for purposes of medical instruction in order to train ordinary general practitioners of medicine. There is no present deficiency in the number of such practitioners, and we certainly have plenty of schools for producing them, so that there is no fear of failure in the supply.

But in medicine, as in every other profession, art, or trade, the supply of the best is never too great, and the demand for something better than that which already exists never ceases.

What, then, does a university, or its medical school, need in order that it may be able to supply the demand for this higher medical education? First, competent teachers; second, suitable buildings, collections, books, and apparatus; third, clinical material. To secure and retain these things requires money, and brains to use it. First, as to the competent teachers. There are many teachers available, but the number of these who have shown that they are competent for, and suited to positions in a medical school which is to supply the best and something better, is limited — much more so than one who has not tried to find them would suppose, and these few are not seeking engagements. How many anatomists, or physiologists, or pathologists, of the

[1] Address delivered before the Medical Faculty of Yale College, June 23, 1891, by John S. Billings, M.D. (Boston Medical and Surgical Journal.)

first class — thoroughly trained, authorities in their special fields, capable of increasing knowledge, and with the peculiar gift of ability to teach — do you suppose there are in this country? It is a liberal estimate to say that a dozen of each have thus far given evidence that they exist. And the great clinical teachers in medicine and surgery, the men who are up to the times in matters of diagnosis, pathology, and therapeutics, and who are also successful teachers both by the spoken and written word, — how many such have we, and especially how many such have we who are not fixed and established, so that they may be induced to go to a school which needs them? Such men are either men of genius — and even this boasted nineteenth century has produced them rarely — or they are men of talent made the most of by unflagging industry with special opportunities, and these are also rare. Yet these are the men whom a great university should seek to obtain and retain for her faculties. To do this, and to get the best work from such men, is by no means a mere matter of salary, although sufficient salaries must be paid. We have also to consider the buildings, collections, books, and apparatus required, and this is largely a question of money. How much money? What would be the cost of establishing and maintaining a first-class medical school in this country at the present time? Let us suppose that one hundred and fifty students are to be provided for, that the course of instruction for those coming with a good high-school education is to occupy four years, and for those coming with the degree of bachelor of arts, and having done at least one year's work in a chemical laboratory and one year's work in a biological laboratory, the course shall occupy three years; that the last year's studies shall be almost exclusively clinical, and that provision is to be made for advanced post-graduate work.

We shall want, then, practical anatomy rooms for fifty students, a physiological laboratory, a pathological laboratory, a pharmacological laboratory, a laboratory of hygiene, and the means of clinical teaching, a library, and a museum. The days have long gone by when one or two amphitheatres or lecture-rooms and a small museum were all the outfit required for medical teaching. The little amphitheatre of the University of Bologna was sufficient for almost every purpose of medical teaching as it was carried on three hundred years ago, but now the lecture-room is the smallest part of the outfit required. In his evidence before the Royal Commission, Professor Lankester stated that to establish such a medical school at Oxford as he thought desirable, about $225,000 would be required for buildings, in addition to those already existing, and that about $100,000 a year would be required for running expenses. Professor Billroth estimates that about $400,000 would be required for buildings for the medical department of a university, exclusive of the buildings for clinical teaching, which he thinks would cost about as much more; and that the annual expense would be about $105,000. He says that these estimates are based on an average standard of efficiency, not the highest, and concludes by saying; "Let us hope that a rich man may some day give three millions of dollars to found a school to be devoted to medicine and natural science."

Perhaps these figures may seem high to you. Yet building is cheaper and salaries lower in England and in Germany than with us, if only first-class work and first-class men are accepted. To build and equip a laboratory which shall give work-room for seventy-five men, will cost here between $75,000 and $100,000. At least four such laboratories are needed by the ideal medical department, besides a building for general lectures, library, etc., which would cost about $50,000.

It is, of course, possible to consolidate all these into a single three or four story building, and thus save money, especially in cost of ground, but the results are not so good. I am not speaking now of temporary, makeshift buildings, but of permanent structures, which though plain should not be hideous, and should be thoroughly well built. Where land is abundant and not too dear, it is usually better to construct these laboratories one at a time, and endeavor to secure for each a proper endowment and equipment. The average expenses of each laboratory may be put at $15,000 per annum. In other words, it requires about $400,000 to build, equip, and endow a physiological, pathological, or hygienic laboratory such as is suited to the needs of a first-class university in this country. By paring down in various directions, this sum can be reduced to $300,000, but not lower without seriously impairing the efficiency of the plan. And in all this I have said nothing of the cost of the means for clinical instruction, which should be borne, in part at least, by the school, for the simple reason that only by doing this can the school have that control of hospital appointments which is so necessary for its proper work.

Of course every professor who is skilled and energetic, and who is imbued with the true university spirit, has innumerable wants and suggestions which require money to supply and carry out. He wants the new books and journals relating to his specialty, specimens, apparatus, models, and illustrations; and if he is at the head of one of the laboratories which I have named, the sum of $15,000 per annum will be required to pay him and his assistants, and to provide for their needs. All this means that the educating of physicians on this plan will cost the medical department between four and five thousand dollars for each graduate. It will receive from them eight hundred to one thousand dollars each, and the balance must be made up from subscriptions, appropriations, or endowments. Practically, endowment is the only resource.

The student himself has to give four or five years' time and labor, and four or five thousand dollars, to obtain his medical education. For some, this expenditure of time and money will be an excellent investment; for others, not, — even if they have enough of both to spare for this purpose. After all, the most that the university can do is to afford opportunities for learning, and a certain kind and amount of stimulus to mental work. The professor may declare that he will teach certain branches; but there are some sent to him for instruction who are not teachable, and the only thing he can do is to return them as little damaged as possible.

The number of men for whom it is specially desirable to provide laboratory and other special facilities for original work in physiology, pathology, pharmacology, and hygiene is limited. There are not a great number of men who have the desire and qualifications necessary for this sort of work, and the number of positions in which they can find remunerative employment in devoting themselves to such investigations is still more limited.

The laboratory facilities in Germany are, as a whole, at present in excess of the number of properly qualified men who can be found to make use of them, although a few are overcrowded.

Advanced work and original investigations cannot, as a rule, be made by undergraduates, if for no other reason than that of lack of time.

Is it advisable that the same medical school shall undertake to furnish such different courses as to provide for all wants — to offer to meet the minimum requirements for the degree of doctor of medicine, as well as the wants of those who demand more advanced and detailed instruction? The answer to this depends largely on the location of the school, and on the means which it can command, especially as regards facilities for hospital and clinical instruction. In any case, its diploma of doctor of medicine should have a uniform value, and if it does undertake the double function, the higher education must be largely post-graduate work. It must also be, to a great extent, a voluntary matter on the part of both schools and students.

As indicated at the beginning, this address is not intended to criticise existing medical institutions, or to give specific advice to any college or university. I have simply tried to formulate roughly what seems to be the present ideal of a course of medical education in the minds of many physicians, and then to show what the carrying out of this ideal involves to the schools and to the students.

I believe in ideals, that is, in their beauty and in their utility when they do not dominate a man so as to make him a visionary, or a dangerous crank or fanatic; but one ideal is often more or less incompatible with another, and all of them must be held subject to the possibilities afforded by surrounding circumstances. But we must not be too sceptical about these possibilities. And we are all directly interested in this matter, every one of us. Every one of this audience will probably see the time when the knowledge and skill of the physician called in to advise in the calamity which has fallen on him or his wife or child will seem to him of vast importance.

Sometimes he can select his physician, often he cannot, but must rely on the first one who can be found. Hence these discussions about medical education, although chiefly carried on by physicians, because they are most familiar with the difficulties of the subject, should be considered by those who are not physicians quite as much as by those who are, or intend to be. It is a dangerous business, however, for a doctor to discuss other doctors in public. He can make more trouble for himself in less time in this way than by almost any other method that I know of. Nevertheless, it is my duty to tell you that there is little probability that the ideal facilities for higher medical education, either here or elsewhere, will be furnished by the doctors themselves. There are several reasons for this, but one is sufficient, and that is, they have not got the money, which I have shown you is necessary to provide and maintain these facilities. Hence, if these ideals are to be realized, the means must be furnished by those who are not members of the medical profession, and it seems to me that this is what will be done.

What is the best way for a university, a real university, to begin this line of work? In most cases I should say by establishing one department at a time on a proper basis. Which departments should be the first to be thus established? Just here is where many of the doctors will begin to differ.

I should say that the first of these departments to be provided for are two which will form the main links in the university bond between the medical and other departments, covering two branches of knowledge which every university graduate should study somewhat, namely, biology and hygiene. For the clergyman, the teacher, the journalist, and the sociologist, systematic instruction in these two branches is as desirable as it is for the physician; for the lawyer it will be useful; only the philologist would I excuse entirely from these departments.

Of course, in specifying that they are to teach, and to teach undergraduates, I do not mean that teaching is to be their sole function. This is not the modern idea of a scientific department of a true university. It is to increase knowledge as well, to provide for the needs of special investigators and seekers who have obtained their elementary training elsewhere.

Let the plans for such a department be well thought out, the expenses carefully estimated, and then bring the matter to the attention of those who have the means to realize this ideal, and sooner or later it certainly will be realized. I have elsewhere ventured to express my sympathy for two classes of men who have in all ages and in all countries received much disapprobation from philosophers, essayists, and reformers, namely, rich men and those who want to be rich.

So far as the wealthy are concerned, there seem to be a good many of them in these latter days who use their stored force to endow universities and professorships, to build libraries and laboratories, and to such let us give due praise and honor. They may not be scientific men, but they make scientific men possible. The unscientific mind has been defined as one which is willing to accept and give opinions without subjecting them to rigid tests. "This is the kind of mind which most of us share with our neighbors. It is because we give and accept opinions without subjecting them to rigid tests" that the sermons of clergymen, the advice of lawyers, and the prescriptions of physicians have a market value. The unscientific public has its uses, and one of its characteristics is a liking for ideals, some of which it occasionally helps to realize. I can only hope that whenever an American university approves the ideal which I have roughly sketched, this public will see that the means are provided for carrying it out. It may be objected by some that it would be better to help to raise the average standard by endowing chairs in the medical schools in large cities, than to provide special facilities for the use of a limited number. It is quite true that all medical schools should be endowed; and this is coming, for voluntary associations of physicians, who are not a wealthy class, cannot afford to compete with endowed schools when State laws shall come to enforce a high standard of acquirements. Nevertheless, we need universities properly so called, as well as colleges and higher schools, and we need university men in the medical profession as well as elsewhere.

I have no fears as to the creation of a medical aristocracy by giving facilities for higher education to those who have the means to avail themselves of them. It is quite true that only a fraction of those who have the means will use these facilities properly, and that there will be a number who have not the means who would make good use of such facilities if they could get them; but these last will not be helped by the total absence of such facilities for anybody. Let us try to give the best minds a chance to obtain the best training; let us try to discover these best minds wherever they may be, and if their owners have not the means to avail themselves of training, let us try to furnish the means. But to do this, one of the first and most essential steps is to provide somewhere the teachers, and the buildings and apparatus, necessary for giving such instruction, and where is a better place to do this than in connection with a university, or, if you please, in connection with this university?

NOTES AND NEWS.

IN the table on page 11 of *Science* for July 3, the totals of the third, fourth, fifth, and seventh columns should be 83, 85, 87, and 120 respectively, instead of 82, 84, 86, and 115.

— The University of Pennsylvania has decided to increase the time given to the subjects of mechanical and electrical engineering by providing additional courses in these subjects, extending over four years.

— Entomologists everywhere will deeply regret to hear of the death of Mr. Henry Edwards, who loved his favorite studies quite as much as he did the stage, and brought to both an ardor and freshness contagious and perennial. "Do mention," writes one of his correspondents to *Psyche*, "his unwearying kindness and unfailing help to entomologists who were more ignorant than himself. I owe much to his help and encouragement, and shall miss him sorely, though I never saw his face." and these qualities which so endeared him to a large cirle of friends were indeed conspicuous in that face. It is understood that Mr. Edwards left little to his widow besides his collection, which is for sale.

— The tanning of elephant hides is comparatively a new industry, according to the *Boston Journal of Commerce*. The method employed is practically the same as in the tanning of cow hide, except that a stronger combination of the tannic ingredients is required, and greater length of time — about six months — is necessary to perform the work. When the hide is taken out of the vat it is an inch and a half thick. Among the articles made of elephant leather are pocket-books, small satchels, cigar-cases, card-cases, and similar articles, and they are said to be expensive luxuries. In finishing the hide, no attempt is made to glaze or polish it, everything being done to preserve its natural color and appearance. The leather is very enduring, several years' wear having but little effect upon it.

— Some experiments were recently made at the Riverside Iron Works, Wheeling, W. Va., on the comparative liability to rust of iron and soft Bessemer steel. As stated in *Engineering*, a piece of iron plate and a similar piece of steel, both clean and bright, were placed in a mixture of yellow loam and sand, with which had been thoroughly incorporated some carbonate of soda, nitrate of soda, ammonium chloride, and chloride of magnesium. The earth as prepared was kept moist. At the end of 33 days the pieces of metal were taken out, cleaned, and weighed, when the iron was found to have lost 0.84 per cent of its weight and the steel 0.72 per cent. The pieces were replaced and after 28 days weighed again, when the iron was found to have lost 2.06 per cent of its original weight and the steel 1.79 per cent.

— In the Pilot Chart for July the attention of masters of vessels is called once more to the importance of using oil to prevent heavy seas from breaking on board their vessels. The following report, printed in the chart, illustrates the fact that even the largest and most powerful vessels may sometimes derive benefits from its use, and that the precaution is especially necessary when a vessel encounters the terrific seas of a West Indian hurricane. Captain Ringk, of the German steamship "Fulda," reports that at 5 A.M., June 9, in latitude 44° 06′ north, longitude 43° 06′ west, the wind lulled to a dead calm for a short time and then suddenly sprang up from the south, shifting to south-west and north-west and blowing a perfect hurricane. The sea was like a boiling mass of foam, and the flying spray prevented those on board from seeing far ahead. Soon a very high and heavy sea came up from the west-south-west, and the ship (westward-bound) labored heavily and shipped a great deal of water. An oil-bag was then used with great success.

— The following appointments to fellowships in the Johns Hopkins University, for 1891–92, are announced: William Wilson Baden of Baltimore, Sanskrit; Edward Ambrose Bechtel of Colora, Md., Latin; Julius Blume of Münster, Germany, Romance languages; Albert Bernhardt Faust of Baltimore, German; Simon Flexner of Louisville, Ky., pathology; Ulysses Sherman Grant of Minneapolis, Minn., geology; William Asbury Harris of Richmond, Va., Greek; Harry Clary Jones of New London, Md., chemistry; James Lawrence Kellogg of Kewanee, Ill., biology; Elmer Peter Kohler of Egypt, Pa., chemistry; Paul Erasmus Lauer of Cleveland, O., history; David Judson Lingle of Chicago, Ill., biology; John Hanson Thomas Main of Baltimore, Greek; Frank Jewett Mather, Jun., of Morristown, N.J., English; Michael Andrew Mikkelsen of Sioux Falls, S.D., history; John Dyneley Prince of New York City, Semitic languages; Brantz Mayer Roszel of Baltimore, astronomy; George Owen Squier of Baltimore, physics; Sydney Grant Stacey of Kezar Falls, Me., Latin; Joseph Moody Willard of Orford, N.H., mathematics.

— The British consul at Hankow, China, writing of the varnish exported from that city, says, according to *Nature*, that he is informed it is the gum of a tree, the *Rhus vernicifera*. On this tree, before daylight, incisions are made, and the gum that runs out is collected in the dark, and strained through a cotton cloth bag, leaving behind a large amount of dirt and refuse. This operation can only be performed in the dark, as light spoils the gum, and causes it to cake with all the dirt in it. It cannot be strained in wet weather, as moisture causes it to solidify. When the Chinese use this varnish, they rub it on with a sort of mop, or swab, made of soft waste silk. It should only be used in wet weather, as, if the atmosphere is dry when it is rubbed on, it will always be sticky. As used by the Chinese, the varnish takes about a month to dry, and during the time it is drying it is poisonous to the eyes. The consul thinks that this gum may have been one of the ingredients of the celebrated Cremona varnish, and he suggests that it might be worth the while of musical instrument makers to experiment with it with a view to producing a varnish that would give a mellow instead of a glassy sound.

— Ever since the story of Robert Bruce and the spider, says a correspondent of *Engineering*, that insect has been proverbially held up to view as an example of pertinacious skill. An attempt to establish instinct as a guide to reason is, however, a fallacy. The setting hen is an example of instinct, not maternal constancy. This perseverance of spiders may have been an encouragement to Robert Bruce, but it is often a discouragement in engineering work. In sinking plumb lines down shafts for middle headings in tunnelling, in order to obtain an alignment for the tunnel, the accuracy of the work is often seriously impaired by spiders attaching their webs to the lines and drawing them towards the walls, often with sufficient tension to introduce material errors in the position of the plumb bobs. In fixing the alignment of the Hoosac Tunnel, in Massachusetts, at the bottom of a shaft 1,028 feet deep, the spiders prevented accurate work with plumb lines, until two cases were made inclosing the whole length of these lines. For shallow pits the spiders' webs can be broken by raising the lines and then lowering them to position shortly before fixing upon points; but in this instance the distance was so great as to require several hours before the vibration of the lines would cease, even with the bobs in vessels of mercury. The suggestion is made that the lines might be freed from similar interferences by insulating the suspended apparatus and the bob from the earth and attaching a grounded electric light circuit to the wire, relying upon the dampness in the pit to give sufficient conductivity to the cobwebs to cause them to be seared by the escape when any cobweb connected the earth to the plumb wire. Many years ago, when the writer used the level with an engineering party, there were frequent difficulties with the instrument. Curved lines like arcs of circles would appear in rapid sequence across the field of vision, which would be nearly eclipsed at times. These difficulties would arise at irregular and generally inconvenient intervals. The instrument was carefully examined without revealing any cause. The writer, distrustful of his own eyesight, visited an eminent oculist, receiving some vague advice and paying a realistic fee. It was afterwards discovered that a minute spider had ensconced himself in the cover of the eyeglass of the telescope of the level. Recently it was found that the meter in the store of a patron of an electric lighting station in America was recording what was a small fraction of the electricity known to be used. The meter was of the revolving fan type, and it was found that a spider had entered the case through a screw hole, and spun a web in such a manner as to prevent the free revolution of the fans. If gas meters were susceptible to similar treatment it is feared there might be a tendency to perforate the cases and imprison spiders therein.

— Mr. E. H. Kern, of Mankato, Kan., writes as follows to *Insect Life:* "Several seasons ago my potato field was almost ruined because I could not use Paris green, as my stock was in danger from it. A large pond of water attracted about twenty of my neighbor's ducks to its shore. I never did fancy ducks very much, and I told him so. He said he would give them to me if I could care for them, as he could not keep them at home. The next morning I went down to the pond at sunrise to try and drive said ducks in a pen. I saw a very curious sight. Headed by an old drake, the twenty ducks were waddling off in a bee-line for my potato field. I crawled into some bushes and awaited developments. As they came to the end of the rows they seemed to deploy right and left, and such a shovelling-in of bugs I never beheld. They meant business, and for fully one-half hour did they continue, until every duck was filled up to its bill with bugs. Then they went for that pond, and I went for their owner and paid him one dollar for the entire bunch — this being all he would accept. When I returned, every duck seemed to be trying to outdo its fellow in noise. This expedition was repeated about 4 P.M., and kept up until every bug went under. I have tried these ducks and others since, and find they all like them, and seem to get fat on potato bugs."

— Fears had been entertained by the citizens of Provincetown, Mass., for some years before 1867 that the harbor was being silted up by the movement of sands from Lancy's Harbor and House Point Island flats on one side, and from East Harbor on the other side, reinforced by such material as might find its way into the harbor from the south side of Long Point. In 1867 a call was made on the United States Coast Survey by the harbor commissioners of Massachusetts for a re-survey of the harbor of Provincetown. This resulted in a survey during that year by the party of Assistant Henry D. Whiting, followed by a report, published as Appendix No. 12, Coast Survey Report for 1867. In this paper, Mr. Whiting discussed the results of a comparison made with the survey of Major Graham in 1835, treating the subject under three heads; first, with reference to changes at Long Point and on House Point Island flats; second, East Harbor Inlet and Beach Point; and third, the beaches at the head of East Harbor. His recommendations for the construction of works for the improvement of the harbor were based upon the conclusions stated in his report, and some of his suggestions have been carried out. A dike was built by the United States at the "wading place" at High Head in 1868–69. Another dike was built across the outlet of East Harbor creek by the State of Massachusetts, effectually cutting off the water communication between East Harbor and the bay, and in 1870 still another dike was thrown across the head of Lancy's Harbor at Abel Hill, to prevent the flow of the tide from that basin into the main harbor. This dike was rebuilt in 1871. A study of the results of the present comparison points decidedly to the conclusion that these improvements have in great measure arrested the forces which were working toward the injury of the harbor. The success of the dike at Abel Hill in arresting the wash of the sands from Lancy's Harbor only points with stronger emphasis to what should be done to arrest the wash of material from House Point Island flats. So long as the low and narrow sandy barrier to the northward of Wood End lighthouse remains intact, the wash off the flats will remain at a minimum, but should the seas make a breach through the beach during a gale, there is no telling what damage might follow, and it would seem the part of prudence for the Government to heed the recommendation made by Mr. Whiting in 1867, and urged again in 1886 by Major Gillespie, United States engineers, that a dike be built from Stevens Point, in Provincetown, to Long Point, thus effectually inclosing the whole of House Point Island flats. The preservation of Long Point (a natural mole guarding the deep-water basin of the harbor), which has been in charge of the United States engineers, should be secured by ample appropriations from Congress. Two comparative maps accompany the paper of which this note is an abstract, and which will be published as an appendix to the "Report of the Coast and Geodetic Survey for 1890." In the preparation of these maps reference was made to Major Graham's map of 1835. A comparison of the entire harbor area outside of the mean low-water line shows that in 1835 this area was 1,302 acres, and that in 1867 it had been reduced to 1,247 acres, a loss of 55 acres in 32 years, or one-tenth of one per cent per year. Between 1867 and 1889 the area increased to 1,274 acres, or 27 acres in 22 years, which is at the rate of nine-thousandths of one per cent per year. The maps confirm these results by indicating a resultant shoreward movement of the submerged contours, leading to the conclusion that the conditions since 1867 are most favorable to the maintenance of the present depths.

— "I recently had a curious bean shown to me by a friend," says a correspondent in *Insect Life*, "and, desiring to learn more about this interesting article, I take the liberty of addressing you on the subject, and will thank you kindly for any information you can give me regarding it. The bean in question came from Mexico, is brown in color, and a section through it at right angles to its length would be a triangle. My friend said the name he had heard for it was 'broncho bean,' given from the fact that it had the power of locomotion, by means of quick, short jumps or tumbles, imparted to it, as I have since learned, by a worm, which claims the bean as its home. The muscular effort exerted by the worm on the interior of the bean is sufficient to propel it forward about three-sixteenths of an inch at each jump. To a person who has not heard the reason for the peculiar action of the bean the movement is, to say the least, wonderful. If there is a printed description of this bean, giving the localities in which it may be found, will you kindly advise me of same?" To which the editor replies: "It is the seed of a euphorbiaceous plant believed to be *Colliguaja odorifera* Moline, and the contained 'worm' is the larva of a little tortricid moth known as *Carpocapsa saltitans*, a near relative of the common codling moth (*Carpocapsa pomonella*). It is found chiefly in Sonora, Mexico."

— At a meeting of the Royal Society, London, on May 18, reported in a recent number of *Nature*, Dr. J. Berry Haycraft gave an account of some experiments which show (1) that the displacements of the heart, which since Harvey's time are supposed to take place with every contraction, do not really occur in the unopened chest, and (2) that the cardiogram has been misinterpreted by physiologists. It is usually supposed that, during each contraction, the heart twists towards the right while its apex moves forward, and, pressing against the wall of the chest, causes the "apex beat." Again, it has been supposed by some that, during expansion, all diameters of the heart are not increased, but that, on the contrary, one diameter is diminished in length. Dr. Haycraft's experiments show that all diameters are increased during expansion, and that all are diminished during contraction. They show also that the motions, above described, do not occur in the unopened chest. The heart, in order that it may be observed in the opened chest, is necessarily separated from its attachments and falls towards the back of the chest (the animal operated upon being supposed to be placed upon its back). During expansion, the heart becomes flaccid, and so is flattened against the back of the chest. The first effect of the stiffening which occurs during the muscular contraction is therefore an elevation of the heart, against gravity, towards the front of the chest. Similarly, if the animal be turned upon one side, the heart, during contraction, moves towards the upper side of the chest; and the "beat" can even be made to take place towards the back. In the unopened chest, the heart on the whole remains in position during contraction, and therefore its boundaries move from the chest walls. But the cardiogram, as usually interpreted, shows that the chest wall is thrown outwards by the impact of the heart during contraction. Dr. Haycraft asserts that this is due to deformation of the heart by pressure of the chest wall when the button of the cardiograph is pressed against the exterior of the chest. The first effect of the muscular contraction and stiffening of the heart is therefore increased pressure against the chest-wall, which gives rise to the up-stroke of the cardiogram. When the cardiograph is made as light as possible, the up-stroke is greatly diminished; but it never entirely vanishes, because the flaccid heart is always slightly distorted by the chest-wall even when the cardiograph is not pressed against it. Dr. Haycraft further shows that the sinuosities, which always appear to a greater or less extent on the cardiogram, are not due to peculiarities in the action of the heart, but are instrumental in their origin, being caused by oscillations which result from the inertia of the cardiograph.

— Writing to the editor of *Insect Life*, Mr. R. J. McGuire, of Rosedale, Miss., says: "Inclosed please find an insect, the name and habits of which you will oblige me by giving. I found it on a willow tree in a swamp on Island 73, in the Mississippi, belonging to Arkansas. I was hunting deer, and being tired lay down under a small willow to rest. After lying there a few moments the air suddenly became filled with little drops of water, as if rain or mist were falling. I got out from under the tree, and as soon as I moved the mist ceased. I stood a short distance away and watched, and gradually came closer, and after watching for half an hour I discovered this little bug on a twig. When I first saw it, it was perfectly quiet, but soon put its head to the limb and immediately minute drops of fluid began to be ejected from the rear end of its body, which extended past or even with the ends of its wings, but since its death it has shrivelled to its present length. The leaves of the tree on which I found it were pierced in thousands of places, and the mist from the tree was thick; but this bug was not on a leaf, but on a small limb. I could find no other insects on the tree, but know there were hundreds. The one I caught slipped around the limb very much as a squirrel would, and I had difficulty in catching it. It made no effort to fly. The natives of the island called the tree a weeping tree, and are very superstitious about it." Replying, the editor says: "The insect which you send is one of the so-called leaf-hoppers, which has been frequently referred to in print on account of its habit of ejecting honey dew and causing the phenomenon of so-called 'weeping-trees.' The scientific name of the one which you send is *Proconia undata*."

— The following appointments from among the graduates of Johns Hopkins' University have recently been made: J. William Black, to be professor of history at Georgetown College, Ky.; Charles C. Blackshear, associate professor of chemistry, Woman's College of Baltimore; Benjamin L. Bowen, associate professor of the Romance languages, Ohio State University; Edwin G. Conklin, professor of biology, Ohio Wesleyan University; Paul J. Dashiell, instructor in organic chemistry, Lehigh University; Alfred Emerson, professor of archæology, Cornell University; Charles H. Haskins, assistant professor of history, University of Wisconsin; George L. Hendrickson, professor of Latin, University of Wisconsin; Francis H. Herrick, Professor of biology, Adelbert College; William H. Hobbs, assistant professor of mineralogy and metallurgy, and curator of the geological museum, University of Wisconsin; Arthur L. Kimball, professor of physics, Amherst College; Oliver P. Jenkins, professor of physiology and histology, Stanford University; James C. Johnston, Loomis fellow in pathology, University of the City of New York; James E. Keeler, professor of astro-physics and director of the observatory at Allegheny City, Penn., James T. Lees, professor of Greek, University of Nebraska; Henry P. Manning, assistant professor of mathematics, Brown University; W. D. McClintock, assistant professor of English literature, University of Chicago; Dice McLaren, director and agriculturist, Wyoming Agricultural Experiment Station; J. Leverett Moore, associate professor of Latin, Vassar College; Ernest M. Pease, professor of the Latin language and literature, Stanford University; George Petrie, professor of history, Alabama Agricultural and Mechanical College; George M. Richardson, assistant professor of inorganic chemistry, Stanford University; Edward B. Rosa, professor of physics, Wesleyan University; Edward A. Ross, professor of political economy, Indiana University; William T. Sedgwick, professor of biology, Massachusetts Institute of Technology; Robert B. Steele, professor of Latin, Illinois Wesleyan University; Bernard C. Steiner, instructor in history, Williams College; William D. Taylor, professor of civil engineering, University of Louisiana; Edward P. Thompson, professor of mathematics, Westminster College, Penn.; Henry A. Todd, Professor of Romance languages, Stanford University; William H. Tolman, instructor in history, New York City; Frederick J. Turner, professor of history, University of Wisconsin; Stephen B. Weeks, professor of history and political science, Trinity College, N. C.; Langdon Williams, instructor in history, Chicago, Ill.; Arthur B. Woodford, assistant professor of political economy, University of Pennsylvania.

— The following appointments have recently been made in the Johns Hopkins University: Maurice Bloomfield, now associate professor, to be professor of Sanskrit and comparative philology; William Hand Browne, now librarian and associate, to be associate professor of English literature; James W. Bright, now associate, to be associate professor of English philology; Professor C. T. Winchester to be one of the lecturers on the Donovan foundation for 1891–92; Professor R. C. Jebb to be the lecturer on the Percy Turnbull memorial foundation for 1891–92; Rev. W. M. Taylor and Rev. R. S. Storrs to be the Levering lecturers in 1891–92; Nicholas Murray, now in charge of the publications, to be librarian; J. S. Ames, now assistant, to be associate in physics; C. H. Chapman, now instructor, to be associate in mathematics; Hermann S. Hering to be associate in electrical engineering; John E. Matzke to be associate in the Romance languages; W. W. Randall to continue as assistant in chemistry; Christopher Johnson, Jun., now fellow, to be instructor in Semitic languages; E. S. Lewis, now fellow, to be assistant in Romance languages; C. C. Marden, now of the University of Michigan, to be assistant in Romance languages; W. S. Symington, Jun., to be assistant in Romance languages; Hermann Schoenfeld, of Columbian University, to be instructor in German; George H. Nuttall to be assistant in bacteriology and hygiene; Edward Renouf to be a member of the standing committee on the gymnasium and its secretary; J. B. Crenshaw to the charge of the gymnasium; G. P. Dreyer to continue in the office of senior demonstrator of physiology; Theodore Hough to continue as junior assistant in the biological laboratory; C. L. Poor, lately a fellow, and now of the College of the City of New York, to be instructor in mathematics; C. A. Smith to be assistant in English; W. A. Scott to be assistant in history; Thomas H. Morgan to hold, for another year, the fellowship in biology founded as a memorial of the late Adam T. Bruce; Edwin G. Conklin to occupy the table allotted to this university in the United States marine laboratory at Wood's Holl.

— Dr. Buchan read a paper before the Royal Society, London, May 18, on the barometer at Ben Nevis observatory, in relation to the direction and strength of the wind (*Nature*, June 18). In arranging the results, Dr. Buchan has referred the direction of the wind to sixteen points of the compass, although the observations are actually made with reference to the thirty-two points. The readings of the barometers at the high-level and the low-level stations, when reduced to sea-level, exhibit marked differences dependent upon the direction of the wind. The investigation extends over the period of nine months commencing in August, 1890. During that time, all the very high winds have been from the east-south east and the south-east, these being the directions in which the wind blows freely along the top of the mountain to the observatory. In eleven cases the wind from these directions attained a speed of 120 miles an hour or more; and the (reduced) barometer at the high-level station read about one-sixth of an inch lower than the instrument at the low-level station. In no other direction was a higher velocity than 70 miles an hour noted; and in the directions from west to north north-west, east, and east-north-east, the velocity was never greater than 30 miles an hour. With northerly winds the instruments at the top of the mountain record a much lower speed than that which, from observations of the drift of the clouds, is seen to be reached at a small height above the top of the mountain. The cause of this comparative calm immediately at the top is the impact of the air upon the face of the cliff which lies to the north of the observatory. The stream lines are thus suddenly deflected upwards. In such cases the depression of the barometer is about three times as great as that which occurs with an equally strong wind from other directions, and indicates the formation of a region of low pressure around the observatory. A peculiar result which is observed with other directions of the wind is that the (reduced) high-level barometric reading exceeds the (reduced) low-level reading when the wind blows at about the rate of 5 miles an hour. The reverse is always true when the speed of the wind exceeds that rate, on the one hand, or is extremely small, on the other. This seems to indicate an increase of pressure in air-currents which ascends the mountain, and so may explain the fact that the top of the mountain is frequently clear, while dense cloud is being constantly formed at a short distance above it.

— On June 27 a scientific expedition, headed by Professor Lee, instructor in biology at Bowdoin College, sailed from Rockland, Me., for Labrador. Of the seventeen members of the party with Professor Lee, nearly all are undergraduates of Bowdoin. The intention is to land four of the party at Hamilton Inlet for a tour of exploration inland, following the inlet and Grand River. The rest of the party will go as far north as Cape Chudleigh.

— The formal transfer of the Weather Bureau from the War Department to the Department of Agriculture took place on July 1. The first official act after the transfer was the appointment of the new chief, Professor Mark W. Harrington of Michigan. Professor Harrington is now and has been for the last twelve years professor of astronomy in the University of Michigan, at Ann Arbor, and editor of the *American Meteorological Journal*. He is about 43 years old. Acting Secretary Grant signed an order on the last day of June discharging the 162 employees of the signal service then engaged in the Weather Bureau. The list is headed by Professor Abbe and ends with the first-class sergeants. Under the law the Secretary of Agriculture is bound to give preference to these men in making appointments for the new Weather Bureau, and, with the exception of a few men who elected to remain in what will hereafter be the purely military branch of the signal service, all of the employees who were engaged in the Weather Bureau will be reappointed.

— According to Professor Elihu Thompson, says *Engineering*, it is not the extra resistance at the break that gives rise to the heating in electric welding. The imperfect contact there no doubt hastens the heating at the joint, but a solid bar placed between the clamps of an electric welding machine can also be raised to the welding temperature, and the bar may be upset there. The real cause of the concentration of the heating between the clamps is the relatively greater conductivity of other portions of the welding circuit, which is usually composed of massive copper conductors kept cool in the case of large work by the circulation of water. By keeping the conductors cool in this way their resistance is maintained constant, and there follows an accentuation of heating effect at the joint, where the rise in temperature increases the resistance. In large works it has been found that hydraulic power can be advantageously employed both for clamping and making contact with the pieces to be welded or worked. In dealing with metals such as lead, tin, and zinc, the temperature required for welding is so low that the metal never glows, and the progress of the heating cannot be watched with the eye. By properly shaping the ends leaden water pipes can easily be welded together end to end. The meeting edges should be thinned so as to reduce the surface of contact below the area of the pipe wall. Joints thus made are very good and sound. Most metals can be welded without the use of a flux, but for good work a flux is often desirable.

— The supplement to the Pilot Chart of the North Atlantic for July illustrates graphically and by means of a tabular statement the drift of every bottle-paper (showing the drift of floating bottles) returned to the hydrographic office at Washington since April, 1889. A small chart of this kind was published last November, but the present supplement is complete up to date. The number of bottle-papers received was 134, of which 119 were from the North Atlantic. The total number of miles drifted by these 119 papers is 103,444, giving an average of 869 miles. There are 113 papers that contain the date of commencement and end of journey, from which the total number of days can be calculated. For these 113 papers the total number of days is 16,969, giving an average of 150 days to each paper. Dividing the average drift by the average number of days, it is found that 5.8 miles per day is the average drift. This figure, it should be remembered, is of necessity less than the true average rate per day, because every day that a bottle lies undiscovered on the beach counts on its time of drift, the apparent elapsed time being thus too great and the average drift per day too small. It is proposed to continue the publication of bottle papers as often as possible, not only for the Atlantic but for other oceans, and masters of vessels and others interested are urged to co-operate with the hydrographic office in collecting as complete data as possible regarding this general subject. Any reliable reports of long drifts of bottle papers, or any other floating objects, will be of interest in this connection, and the accumulation of such data may add considerable useful information to our knowledge of the general drift of ocean currents.

— On Thursday, May 21, says the *Lancet*, the body of an Arab, found dead on one of the ships in the Albert Docks, was taken to the Seamen's Hospital, name unknown. A necropsy was ordered by the coroner, and made by Dr. F. Croucher, house surgeon to the branch hospital. There were no signs of disease in the brain or the chest, except a few old adhesions in the left pleural cavity. The gall bladder was very distended and full. Three small ulcers existed on the anterior coat of the stomach. Several patches of inflammation were found in the small intestine. In the cæcum were found twenty buttons, three cog-wheels (apparently out of a watch, two of them one inch in diameter, and doubled), one two-inch steel screw bent double, and one one-inch screw, six pieces of a lock (the biggest piece one and a half inch long and one and a half inch broad), a circular piece of brass (one and three-quarter inch in diameter folded into four), several pieces of iron wire (four were one and a half inch in length), brass, and lead, and two key tallies on a ring, one inch in length. In the ascending colon, about five inches from the cæcum, were found a piece of steel wire one eighth of an inch in diameter, and three inches and a half in length, bent double, and one small cog-wheel. The weight of these bodies together amounted almost exactly to half a pound. The body was much emaciated; no subcutaneous fat was present in chest or abdominal walls, or any fat round the kidneys. The deceased was quite unknown ; no particulars could be discovered by the police employed to obtain evidence for the purposes of the inquest. There was no perforation of intestines, nor any sign of disease in the colon.

— Dr. Roland Thaxter has received an appointment as assistant professor of cryptogamic botany and Mr. J. G. Jack as arboretum lecturer for 1891–92 at Harvard University.

— Dr. J. F. Williams of the Geological Survey of Arkansas has been appointed assistant professor of geology at Cornell University. He has in press a volume upon the igneous rocks of Arkansas.

— J. M. Stedman, formerly of Cornell University, now of the United States Department of Agriculture, has just accepted an invitation to the chair of biology in Trinity University, Durham, N.C. This institution has been completely reorganized, and will open in September, with the following new departments : medical college; law school; schools of arts, literature, political and social science, and divinity; and a college of the sciences.

— Mr. John M. Barr, well known as a member of the American Society of Mechanical Engineers, and now professor of mechanical engineering at the University of Minnesota, has resigned his position to accept a call to Sibley College, Cornell University, where he will have special charge of the whole line of junior work in machine-design lately conducted by Professor A. W. Smith. Professor Smith goes to the University of Wisconsin for the present, with the expectation that he may go to the Stanford University a year later.

— Mr. C. H. Tyler Townsend some time ago resigned his position in the Division of Entomology, United States Department of Agriculture, to accept the post of entomologist to the State experiment station of New Mexico. By a competitive civil service examination his place has been filled by Mr. F. H. Chittenden of New York, formerly editor of *Entomologica Americana*, and curator and corresponding secretary of the Brooklyn Entomological Society. Mr. A. B. Cordley, formerly entomologist of the Agricultural experiment station of Vermont, has also been appointed to a position in the division.

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

THE FARADAY CENTENARY.

ON Wednesday, June 17, at the Royal Institution, London, Lord Rayleigh delivered a lecture in connection with the one hundredth anniversary of Faraday's birth. The following abstract of the lecture is from *Nature* of June 25.

Lord Rayleigh said that the man whose name and work they were celebrating was identified in a remarkable degree with the history of that institution. If they could not take credit for his birth, in other respects they could hardly claim too much. During a connection of fifty-four years, Faraday found there his opportunity, and for a large part of the time his home. The simple story of his life must be known to most who heard him. Fired by contact with the genius of Davy, he volunteered his services in the laboratory of the institution. Davy, struck with the enthusiasm of the youth, gave him the desired opportunity, and, as had been said, secured in Faraday not the least of his discoveries. The early promise was indeed amply fulfilled, and for a long period of years, by his discoveries in chemistry and electricity, Faraday maintained the renown of the Royal Institution and the honor of England in the eye of the civilized world. He should not attempt in the time at his disposal to trace in any detail the steps of that wonderful career. The task had already been performed by able hands. In their own "Proceedings" they had a vivid sketch from the pen of one whose absence that day was a matter of lively regret. Dr. Tyndall was a personal friend, had seen Faraday at work, had enjoyed opportunities of watching the action of his mind in face of a new idea. All that he could aim at was to recall, in a fragmentary manner, some of Faraday's great achievements, and if possible to estimate the position they held in contemporary science.

Whether they had regard to fundamental scientific import, or to practical results, the first place must undoubtedly be assigned to the great discovery of the induction of electrical currents. He proposed first to show the experiment in something like its original form, and then to pass on to some variations, with illustrations from the behavior of a model, whose mechanical properties were analogous. He was afraid that these elementary experiments would tax the patience of many who heard him, but it was one of the difficulties of his task that Faraday's discoveries were so fundamental as to have become familiar to all serious students of physics.

The first experiment required them to establish in one coil of copper wire an electric current by completing the communication with a suitable battery; that was called the primary circuit, and Faraday's discovery was, that, at the moment of the starting or stopping of the primary current, then, in a neighboring circuit, in the ordinary sense of the words, completely detached, there was a tendency to induce a current. He had said that those two circuits were perfectly distinct, and they were distinct in the sense that there was no conducting communication between them, but, of course, the importance of the experiment resided in this, — that it proved that in some sense the circuits were not distinct; that an electric current circulating in one does produce an effect in the other, which is propagated across a perfectly blank space occupied by air, and which might equally well have been occupied by vacuum. It might appear that that was a very simple and easy experiment, and of course it was so in a modern laboratory, but it was otherwise at the time when Faraday first made it. With all his skill, Faraday did not light upon truth without delay and difficulty. One of Faraday's biographers thus wrote: "In December, 1824, he had attempted to obtain an electric current by means of a magnet, and on three occasions he had made elaborate and unsuccessful attempts to produce a current in one wire by means of a current in another wire, or by a magnet. He still persevered, and on August 29, 1831, — that is to say, nearly seven years after his first attempts, — he obtained the first evidence that an electric current induced another in a different circuit. On Sept. 23 he writes to a friend, 'I am busy just now again with electro-magnetism, and think I have got hold of a good thing, but cannot say; it may be a weed instead of a fish that, after all my labor, I at last haul up.'" We now know that it was a very big fish indeed.

About the time that the experiments of which he had been speaking were made, Faraday evidently felt uneasiness as to the soundness of the views about electricity held by his contemporaries, and to some extent shared by himself, and he made elaborate experiments to remove all doubt from his mind. He re-proved the complete identity of the electricity of lightning and of the electricity of the voltaic cell. He was evidently in terror of being misled by words which might convey a meaning beyond that which facts justified. Much use was made of the term "poles" of the galvanic battery. Faraday was afraid of the meaning which might be attached to the word "pole," and he introduced a word since generally substituted, "electrode," which meant nothing more than the way or path by which the electricity was led in. "Electric fluid" was a term which Faraday considered dangerous, as meaning more than they really knew about the nature of electricity, and, as was remarked by Maxwell, Faraday succeeded in banishing the term "electric fluid" to the region of newspaper paragraphs.

Diamagnetism was a subject upon which Faraday worked, but it would take too long to go into that subject, though a word or two must be said. Faraday found that whereas a ball of iron or nickel or cobalt, when placed near a magnet or combination of magnets, would be attracted to the place where the magnetic force was the greatest, the contrary occurred if for the iron was substituted a corresponding mass of bismuth or of many other substances. The experiments in diamagnetism were of a microscopic character, but he would like to illustrate one position of Faraday's, developed years afterwards by Sir William Thomson, and demonstrated by him in many beautiful experiments, only one of which he now proposed to bring before them. Supposing they had two magnetic poles, a north pole and a south pole, with an iron ball between them, free to move along a horizontal line perpendicular to that joining the poles, then, according to the rule he had stated, the iron ball would seek an intermediate position, the place at which the magnetic force was the greatest. Consequently, if the iron ball be given such a position, they would find it tended with considerable force to a central position of equilibrium; but if, instead of using opposite poles, they used, e.g., two north poles, they would find that the iron ball did not tend to the central position, because that was not the position in which the magnetic force was the greatest. At that position there was no magnetic force, for the one pole completely neutralized the action of the other. The greatest force would be a little way out, and that, according to Faraday's observations, systematized and expressed in the form of mathematical law by Sir William Thomson, was where the ball would go.

The next discovery of Faraday to which the lecturer called attention was one of immense significance from a scientific point of view, the consequences of which were not even yet fully understood or developed. He referred to the magnetization of a ray of light, or what was called in more usual parlance the rotation of the plane of polarization under the action of magnetic force. It would be hopeless to attempt to explain all the preliminaries of the experiment to those who had not given some attention to those subjects before, and he could only attempt it in general terms. It would be known to most of them that the vibrations which constituted light were executed in a direction perpendicular to that of the ray of light. By experiment he showed that the polarization which was suitable to pass the first obstacle was not suitable to pass the second, but if by means of any mechanism they were able, after the light had passed the first obstacle, to turn round the vibration, they would then give it an opportunity of passing the second obstacle. That was what was involved in Faraday's discovery. As he had said, the full significance of the experiment was not yet realized. A large step towards realizing it, however, was contained in the observation of Sir William Thomson, that the rotation of the plane of polarization proved that something in the nature of rotation must be going on within the medium when subjected to the magnetizing force, but the precise nature of the rotation was a matter for further speculation, and perhaps might not be known for some time to come.

When first considering what to bring before them, the speaker thought, perhaps, he might include some of Faraday's acoustical experiments, which were of great interest, though they did not attract so much attention as his fundamental electrical discoveries. He would only allude to one point which, as far as he knew, had never been noticed, but which Faraday recorded in his acoustical papers. "If during a strong steady wind, a smooth flat sandy shore, with enough water on it, either from the receding tide or from the shingle above, to cover it thoroughly, but not to form waves, be observed in a place where the wind is not broken by pits or stones, stationary undulations will be seen over the whole of the wet surface. . . . These are not waves of the ordinary kind; they are (and this is the remarkable point) accurately parallel to the course of the wind." When he first read that statement, many years ago, he was a little doubtful as to whether to accept the apparent meaning of Faraday's words. He knew of no suggestion of an explanation of the possibility of waves of that kind being generated under the action of the wind, and it was, therefore, with some curiosity that two or three years ago, at a French watering-place, he went out at low tide, on a suitable day when there was a good breeze blowing, to see if he could observe anything of the waves described by Faraday. For some time he failed absolutely to observe the phenomenon, but after a while he was perfectly well able to recognize it. He mentioned that as an example of Faraday's extraordinary powers of observation, and even now he doubted whether anybody but himself and Faraday had ever seen that phenomenon.

Many matters of minor theoretic interest were dealt with by Faraday, and reprinted by him in his collected works. The speaker was reminded of one the other day by a lamentable accident which occurred owing to the breaking of a paraffin lamp. Faraday called attention to the fact, though he did not suppose he was the first to notice it, that, by a preliminary preparation of the lungs by a number of deep inspirations and expirations, it was possible so to aërate the blood as to allow of holding the breath for a much longer period than without such a preparation would be possible. He remembered some years ago trying the experiment, and running up from the drawing-room to the nursery of a large house without drawing any breath. That was obviously of great practical importance, as Faraday pointed out, in the case of danger from suffocation by fire, and he thought that possibly the accident to which he alluded might have been spared had the knowledge of the fact to which Faraday drew attention been more generally diffused.

The question had often been discussed as to what would have been the effect upon Faraday's career of discovery had he been subjected in early life to mathematical training. The first thing that occurred to him about that, after reading Faraday's works, was that one would not wish him to be anything different from what he was. If the question must be discussed, he supposed they would have to admit that he would have been saved much wasted labor, and would have been better *en rapport* with his scientific contemporaries if he had had elementary mathematical instruction. But mathematical training and mathematical capacity were two different things, and it did not at all follow that Faraday had not a mathematical mind. Indeed, some of the highest authorities (and there could be no higher authority on the subject than Maxwell) had held that his mind was essentially mathematical in its qualities, although they must admit it was not developed in a mathematical direction. With these words of Maxwell he would conclude: "The way in which Faraday made use of his idea of lines of force in co-ordinating the phenomena of electric induction shows him to have been a mathematician of high order, and one from whom the mathematicians of the future may derive valuable and fertile methods."

THE "SUBMARINE SENTRY."

AT a recent meeting of the Royal United Service Institution, London, a lecture upon sounding machines was given by Professor Lambert of the Royal Naval College, Greenwich. In the course of the lecture (some details of which appear in *Engineering* of June 26) a description was given of an instrument called a "submarine sentry," which has been successfully experimented with on some ships of the British navy. It is the invention of Mr. Samuel James, a civil engineer.

As described by the lecturer, the sentry is intended to give a continuous under-water look-out, and to automatically give warning of the approach of shallow water. It consists of an inverted wooden kite, which can be trailed at the stern of a vessel at any required depth to forty-five fathoms. On striking bottom, the blow, acting on a projecting trigger, releases the slings of the kite and causes it to rise to the surface and trail in the wake of the vessel. At the instant of striking, the sudden loss of tension in the wire sounds a gong attached to a winch on board the ship. The wire used is of steel, and of the highest tenacity attainable. Its diameter is 0.067 of an inch, and it is capable of bearing a stress of fully a thousand pounds. During towing the vibration of the wire causes a continuous rattle in a sounding box, and the cessation of this noise gives an additional indication when the sentry has struck the bottom. The vertical depth of the kite at any time is indicated on the dial plate of the winch. The curve formed by the wire while towing is concave downwards, and at first sight it would appear as if this curve would change its form, and the sinker trail further astern and at less depth when the ship's speed was increased. Professor Lambert had carefully plotted out this curve, and showed the results on a diagram. By a mathematical analysis he showed that the instrument would remain constant in its record at any speed of the ship between five and fifteen knots. The weight of the kite is equal to, and is therefore neutralized by, its own buoyancy, and the weight of the wire is negligible compared to the forces due to the motion through the water.

The forces which remain to be considered are, (1) the fluid pressure on the kite, (2) the fluid pressure on the under side of the wire, and (3) the tension of the wire. The latter is the result of the two former. Pressures due to fluid motion vary nearly as the square of the velocity. If, therefore, the velocity of the ship be doubled, forces (1) and (2) will each be multiplied by four, the three forces will all be changed proportionally, and there will be no change in the direction in which they act. This is only put forward as a rough explanation of the phenomena, but that it is practically true has been, it is claimed, corroborated by practical tests, — the depth of the sinker not varying more than half a fathom in thirty at speeds of from five to thirteen knots, above which speed the instrument is not designed to be used.

There are two descriptions of kite, one set at an angle to give soundings down to thirty fathoms, and the other slung so as to register down to forty-five fathoms. With the former about four and a half horse-power is absorbed at a speed of eight knots. It should be stated that the apparatus can be used for taking soundings at any depth within its limits of working, as well as to form a permanent indication of when the ship passed into water of less than a given depth. All that is required to do is to pay the kite out slowly, with a hand on the brake which is provided for checking the speed. When the gong sounds, a glance at the dial will show the vertical depth due to the length of wire paid out.

EXPERIMENTS WITH LEYDEN JARS.

At a meeting of the Physical Society, London, held June 12 (reported in *Engineering* of June 19), some experiments with Leyden jars were shown by Dr. Lodge. The first one was with resonant jars, in which the discharge of one jar precipitated the overflow of another when the lengths of the jar circuits were properly adjusted or tuned. The latter jar was entirely disconnected from the former, and was influenced merely by electromagnetic waves emanating from the discharging circuit. Lengthening or shortening either circuit prevented the overflow. Correct tuning was, he said, of great importance in these experiments, for a dozen or more oscillations occurred before the discharge ceased. The effect could be shown over considerable distances. In connection with this subject Mr. Blakesley had called his attention to an observation made by Priestley many years ago, who noticed that when several jars were being charged from the same prime conductor, if one of them discharged, the others would sometimes also discharge, although they were not fully charged. This he, Dr. Lodge, thought might be due to the same kind of influence which he had just shown to exist. The word "resonance," he said, was often misunderstood by supposing it always had reference to sound, and as substitutes he thought that "symphoning" or "symphonic" might be allowable.

The next experiment was to show that wires might be tuned to respond to the oscillation of a jar discharge, just as a string could be tuned to respond to a tuning-fork. A thin stretched wire was connected to the knob of a jar, and another parallel one to its outer coating, and, by varying the length of an independent discharging circuit, a glow was caused to appear along the remote halves of the stretched wires at each discharge. Each of the wires thus acted like a stopped organ pipe, the remote ends being the notes at which the variations of pressure are greatest. By using long wires he had observed a glow on portions of them with the intermediate parts dark: this corresponded with the first harmonic, and by measuring the distance between two nodes, he had determined the wave length of the oscillations. The length so found did not agree very closely with the calculated length, and the discrepancy he thought due to the specific inductive capacity of the glass not being the same for such rapidly alternating pressures as for steady ones. He also showed that the electric pulses passing along a wire could be caused (by tuning) to react on the jar to which it was connected, and cause it to overflow, even when the distance from the outside to the inside coating was about eight inches. During this experiment he pointed out that the noise of the spark was greatly reduced by increasing the length of the discharging circuit. The same fact was also illustrated by causing two jars to discharge into each other, spark gaps being put both between their inner and outer coatings, so as to obtain "A" sparks and "B" sparks. By putting on a long "alternative path" as a shunt to the B spark gap, and increasing that gap, the noise of the A spark was greatly reduced. He had reason to believe that the B spark was a quarter phase behind the A spark, but the experimental proof had not been completed.

He next described some experiments on the screening of electromagnetic radiation, in which a Hertz resonator was surrounded by different materials. He had found no trace of opacity in insulators, but the thinnest film of metal procurable completely screened the resonator. Cardboard rubbed with plumbago also acted like a nearly perfect screen. In connection with resonators he exhibited what he called a graduated electric eye, or an electric harp, made by his assistant, Mr. Robinson, in which strips of tinfoil of different lengths are attached to a glass plate, and have spark gaps at each end which separate them from other pieces of foil. One or other of the strips would respond according to the frequency of the electro-magnetic radiation falling upon it.

A GIFT TO THE UNIVERSITY OF CHICAGO.

The executors of the estate of the late William B. Ogden, who was the first mayor of Chicago, have selected the University of Chicago as one of the beneficiaries under the terms of Mr. Ogden's will, — giving it a scientific school.

The conditions attached by the executors to the gift — which will amount to from three hundred thousand to half a million dollars — are, that the school shall be a separate department of the university, and bear the name of the Ogden Scientific School, its purpose being to furnish graduate students with the best facilities possible for scientific investigation by courses of lectures and laboratory practice. The income of the money appropriated is to be devoted to and used for the payment of salaries and fellowships, and the maintenance of laboratories in physics, chemistry, biology, geology, and astronomy, with the subdivisions of these departments. A large share of the time of the professors in the school is to be given to original investigation, and encouragement of various kinds is to be furnished them to publish the results of their investigations, a portion of the funds being set apart for the purpose of such publication. The school is to include all the graduate work of the university on the subjects mentioned, and further appropriations or donations which may be made toward these objects are to be added to the original foundation, and not to be devoted to new schools doing similar or parallel work. Some portion of the income of the foundation is to be set apart for the purchase of books to be placed in the special departmental and laboratory libraries of the proposed school.

The university in accepting this gift is required to pledge itself to erect the contemplated school, under the suggested name, on the receipt of $300,000, whether or not the wish and expectations of the trustees be realized in the final receipt from the fund of a much larger sum. In the event, however, of any unforeseen circumstances preventing the money designated from reaching the sum of $300,000, the money which may be received shall be used for the endowing of one or more professorships in the university to be severally known as the Ogden Professorships.

It is further desired that at least one of the board of trustees of the university shall be the nominee of the executors and trustees of Mr. Ogden's estate, in order that in the formation and development of the scientific school proposed, the wishes of the trustees may be voiced by at least one member of the governing board of the university. And finally it is required that it shall be distinctly understood that there shall be absolute freedom in respect to the admission to the proposed school of students and professors alike, without reference to their particular religious beliefs.

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.*

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The Dissipation of Energy.

In passing through a grove of scattered timber after a recent thunder-storm, I came to a tree that had been struck by lightning, a honey-locust (*Gelditschia*), about two feet in diameter.

At the bifurcation of the topmost limbs the bark and sap-wood were torn off for two or three inches in width, increasing as it passed down, until within ten feet of the ground, where it seemed to pass in and explode from the centre, splintering the tree on one side for a foot or two, then tearing the bark and sap-wood for a little ways down, and then leaving the rest without a mark on it for two or three feet above the roots. The splinters were scattered in a half circle twenty feet from the tree. The tree appeared to be perfectly sound and free from defect.

Some years ago I saw something similar in an eastern State. A hemlock tree, two feet in diameter, had a small streak of bark taken off one side from the top down for ten or twelve feet, and then the whole body of the tree was shattered, and as much as six feet of it scattered in every direction, and the top was left standing erect on the stump. There were no marks on the tree below the splintered part.

In both cases there seemed to be no evidence of cracks or defects previous to the explosion. P. J. FARNSWORTH.

Clinton, Iowa, June 28.

The Relations of the Eastern Sandstone of Keweenaw Point to the Lower Silurian Limestones.

ONE of the assistants (Mr. W. L. Honnold) of the Michigan Geological Survey has been engaged in the study of the relations of the limestone west of L'Anse to the eastern or supposed Potsdam sandstone of the copper-bearing range. This locality is described in Jackson's Report (1849, pp. 399, 452), Foster and Whitney's Report (part 1., 1850, pp. 117–119), and in Rommger's Report (1873, I. part 3, pp. 69–71); and the limestone considered from its fossils to be Trenton or some adjacent Lower Silurian strata. It was inferred by Jackson that the limestone underlies the sandstone, but by the other observers that it overlies it, although no direct contact was seen.

Excavations made by Mr. Honnold's party and reported by him have developed the contact of the two formations, and show that the two form a synclinal or oblong basin-shaped fold, with the limestone overlying, and in direct contact with the sandstone. The existence of this fold in the sandstone, as well as in the limestone, removes the difficulty previous observers have had in reconciling the obviously tilted limestone with the supposed horizontal sandstone, and proves that the eastern sandstone exposed here is of Lower Silurian age, and older than this limestone.

At the point of contact of the two formations, exposed by excavation, the sandstone and limestone appear to be conformable, and they are seen to constantly agree in dip and strike. The contact between the two formations is abrupt, without any beds of passage, although the upper layers of the sandstone contain considerable carbonate of lime and magnesia, and the lower layers of the limestone much silica.

These observations are considered to be confirmatory of the commonly received view of the Potsdam age of the eastern sandstone; while the contorted state of the sandstone, extending at least a mile and a half west from the limestone locality, may have weight in deciding the relative age of the eastern sandstone and the copper-bearing rocks.

A careful study of the fossils will be made and additional field work done, when the results will be published in detail.

M. E. WADSWORTH.

Michigan Mining School, Houghton, July 3.

AMONG THE PUBLISHERS.

THE J. B. Lippincott Company announce as in press, "Harmony of Ancient History," by Malcolm Macdonald; "Chambers's Encyclopædia," Vol. VIII. (entirely new edition, revised and rewritten); "The Chemical Analysis of Iron," by Andrew Alexander Blair (new edition); and "A Hand-Book of Industrial Organic Chemistry," by S. C. Sadtler.

— "Whatever else we may think of this Russian censorship," says a writer in the *Pall Mall Budget*, "it must at least be admitted that its officialls do their work conscientiously. A few copies of Miss Hawker's 'Mademoiselle Ixe' were recently posted to various addresses in Russia. Thsy are now coming back to the senders with the word *Défendu* stamped on their covers. One of these returned copies now lies before me. Its leaves are cut from end to end, and evidently the book has been handled and read. Moreover, on turning over the pages, I find red pencil marks placed at various passages in the earlier part of the story. After a time they stop. The censor saw, I suppose, that it was a clear case for prohibition, and did not trouble to score the obnoxious sentiments any further. It is a compliment, however, to the authoress that he read the story to the end — as I judge by marks of another kind."

— Dr. Paul Carus has issued, through the Open Court Publishing Co., a new edition of his "Fundamental Problems." The body of the work is not altered much; but an appendix of a hundred pages is added, in which the author enters into a quite extended discussion of some of the questions that the book raises, and replies to some of his critics. Those who agree with his general views on philosophy he treats with respect, though stoutly maintaining his own views in opposition to others; but those who have attacked his fundamental principles he treats testily and with scant courtesy. His doctrine is in no respect modified in the new edition, but remains the same rank materialism as before — a materialism not in the least disguised by calling it "monism." It is stated, too, in the same dogmatic language, in the new edition as in the old, thus: "It is undeniable that immaterial realities can not exist. The thing exists by its being material" (p. 86). Dr. Carus's book will doubtless please those of his way of thinking; but it will do nothing towards converting any one who holds opposite views.

— Leach, Shewell, & Sanborn, of New York and Boston, have just published "The Number-System of Algebra," by Professor Henry B. Fine of Princeton. The theoretical part of the book is an elementary exposition of the nature of the number-concept, of the positive integer, and of the "four artificial forms of number which, with the positive integer, constitute the 'number-system' of algebra, viz., the negative, the fraction, the irrational, and the imaginary." The point of view of the author is the one first suggested by Peacock and Gregory, that algebra is completely defined formally by the laws of combination to which its fundamental operations are subject: that, speaking generally, these laws alone define the operations; and that the operations define the various artificial numbers, as their formal or symbolic results. The historical part of the volume contains a review of the history of the most important parts of elementary arithmetic and algebra.

— NO. 38 of the Scovill Photographic Series, just published, is "Photographic Reproduction Processes," by P. C. Duchochois (New York, Scovill & Adams Co., $1.) It makes a neat octavo volume of 121 pages, and is a practical treatise on photo-impressions without silver salts, for the use of photographers, architects, engineers, draughtsmen, and wood and metal engravers. The author describes, in language readily understood by both amateur and professional, all the processes employed to reproduce plans, designs, engravings, *clichés* on paper, wood, glass, and metal plates; besides giving a complete description of the uranotype, analine, platinotype, and improved carbon processes. The authors quoted are almost "legion," but the quotations are judiciously made; and as the point in view is to show results, as well as how to achieve them in the most direct way, the quotations are of immediate benefit to the reader without detracting in the slightest from the credit due the person quoted from, due credit being given in each instance.

— A recent issue of the Johns Hopkins Press is a pamphlet on the "Public Lands and Agrarian Laws of the Roman Republic," by Andrew Stephenson. It begins with a brief account of the land belonging to early Rome, the *Ager Romanus* and the *Ager Publicus*, followed by a general description of the Roman colonies, whose history is inseparably bound up with that of the land. The author then proceeds to describe in considerable detail the various agrarian laws, from the Lex Cassia to the establishment of the empire. To give a thoroughly satisfactory account of the Roman land laws apart from the general history of the republic is hardly possible; but, allowance being made for that drawback, Mr. Stephenson's work is worthy of praise. It is somewhat dry in style, but it gives evidence not only of a careful study of the facts but of a good deal of thinking about the facts. We like in particular the care with which the author expounds the character and meaning of the various laws under review, the circumstances which led to their enactment, and the actual effect they had. Mr. Stephenson informs us in his preface that this monograph is intended, not merely as a study in Roman history, but also as the precursor of a book on agrarian movements in recent times and in nations nearer home.

— The seventh volume of "Chambers's Encyclopædia," which has just appeared, ranges from Maltebrun to Pearson. Geographical articles are the most prominent feature of the volume, there being descriptions of no less than seventeen of the American States and Territories, together with articles on Mexico, New Zealand, several of the Canadian provinces, and the cities of Paris, New York, Moscow, and many others. The articles on the different parts of the United States are by American writers, and a few other articles are also from American pens. Besides the geographical papers mentioned, there are various other articles of interest to men of science. Professor P. G. Tait treats of "Matter," Dr. J. P. Steele of "Medicine," and Dr. John Murray describes the Pacific Ocean and the Mediterranean Sea. The Rev. E. B. Kirk treats of the moon and of meteors, Professor James Geikie of mountains and of paleontology, Dr. Buchan of meteorology, etc. Literature and history are less fully represented; but there are papers on novels, newspapers, mythology, etc., and sketches of Mills, Milton, Napoleon, and many less noted men. Among the most important papers in the volume are those on Mohammed and the religion he founded, written by Professor Emmanuel Deutsch and Rev. John Milne; while the longest of all the articles, we believe, is on the subject of the navy. Other noticeable papers treat of painting, music, parliament, numismatics, and, in short, of all important topics in this part of the alphabetical list. The volume is characterized by the same qualities that we have noted in the earlier ones, clearness and conciseness combining to convey a large amount of information in available form and in moderate space. Published in this country by J. B. Lippincott Co., Philadelphia.

— While engaged in explorations on behalf of the Geological Survey of Canada in 1889 and 1890, Mr. J. B. Tyrrell discovered an area of Silurian rocks on the north-east side of Lake Winnipegosis, on Cedar Lake, and on the Saskatchewan River below Cedar Lake. From these rocks an interesting series of fossils was obtained, some of which are apparently new to science. Of these latter, four of the most characteristic or important species are described and illustrated in a pamphlet just issued by J. F. Whiteaves, entitled "Descriptions of Four New Species of Fossils from the Silurian Rocks of the South-eastern Portion of the District of Saskatchewan."

— In the August *Popular Science Monthly*, Hon. Carroll D. Wright discusses the value of statistics, explaining how tables of figures should be used, and showing how they are sometimes made to give false evidence; Dr. Andrew D. White, in his article entitled "From Fetich to Hygiene," presents a terrible picture of the ravages of epidemics in times when prayers and processions were the only means relied upon to check them; Mr. S. N. D. North concludes "The Evolution of the Woolen Manufacture," with dyeing and finishing processes, and some general features of the industry (fully illustrated). The same number contains the first of a series of illustrated articles on "Dress and Adornment."

Publications received at Editor's Office, June 24-July 14.

CHAMBERS'S ENCYCLOPÆDIA. New ed. Vol. VII. Maltebrun to Pearson. Philadelphia, Lippincott. 828 p. 4°. $3.

DUCHOCHOIS, P. C. Photographic Reproduction Processes. New York, Scovill & Adams Co. 121 p. 8°. $1.

HORNADAY, W. T. Taxidermy and Zoological Collecting. New York, Scribner. 362 p. 8°. $2.50.

PERKINS, F. C. Cornell University and her General and Technical Courses. New York, Wiley. 78 p. Oblong, 6¼x9¼. $1.50.

by Professor Frederick Starr, two instalments of Gladstone's discussion with Huxley, and an article on "Head-flattening among the Navajo Indians," by Dr. R. W. Shufeldt.

— The Forest and Stream Publishing Co. have ready a second and enlarged edition of C. P. Kunhardt's "Small Yachts, their Designs and Construction." The work has been extended by the addition of many new plates.

— Among the more recent publications of the American Book Company is "Advanced Lessons in English Grammar," by W. H. Maxwell, superintendent of public instruction in Brooklyn. It is intended for use in higher grammar classes. It is the third volume of Maxwell's English series, and the work embraces all the theory and practice necessary during the last two years of a grammar school course, or throughout a high school course. It is intended to serve the double purpose of a text-book and a book of reference. A valuable feature of the book is the chapter on economy of attention, based on Herbert Spencer's "Essay on Style."

— The Humboldt Publishing Co., 19 Astor Place, New York, announce for issue: "Mental Suggestion," by Dr. J. Ochorowicz. It is on the phenomena of hypnotism and animal magnetism, treated both historically and critically.

"Teaching in Both Continents" is the title of a volume by E. C. Grasby, introduced to American readers by Professor W. T. Harris, which will be published by the Cassell Publishing Co. It is a comparative study of our school system in connection with those of other nations. "In this book," says Professor Harris, "we have the rare opportunity of seeing our educational system as it appears to one of our large-minded cousins from the opposite side of the world;" and, he adds, "the very intelligent criticisms of Mr. Grasby will be read with profit by all our teachers and school directors."

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Aquarium.
Infusoria, Protozoa, etc., Practical Methods of Preparation.
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Pedesis (Brownian Movement).
Collectors' Notes for June.
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SCIENCE

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SCIENCE

NEW YORK, JULY 17, 1891.

THE PHOTOCHRONOGRAPH.

THE observations described and discussed in a recent publication of the Georgetown College observatory had their origin in a visit made by Professor Frank H. Bigelow and Mr. G. Saegmüller to that observatory in the summer of 1889. Their object was to use the observatory's five-inch equatorial for a series of experiments in photographing star transits. All the resources of the observatory were most cordially placed at their disposal by the director, the Rev. J. G. Hagen, and on Aug. 12, 1889, the first apparatus was tested.

The experiments were repeated on Aug. 26 with an improved apparatus, and were then broken off, for the time being, by the appointment of Professor Bigelow to the West African eclipse expedition.

The purpose of the method of observation described is the removal of the "personal equation" in transit observations, by means of photography. One night, Professor Bigelow, to whom the idea is due, and Mr. Saegmüller, an instrument-maker of Washington, were sitting with the director of the observatory at the table in the library, and consulting as to the best way of putting the idea to a test. The long focus of the equatorial and the electrical connections for the time-signals and incandescent lamps came in very handy for the purpose. The first camera was soon constructed and screwed to the eye end of the telescope, and a few evenings later the star Alpha Aquilæ was made to trace its diurnal motion on a small plate not quite two inches square, while the siderial clock made the whole camera move in a vertical direction once every second. Finally, the spider-lines of the micrometer were photographed on the same plate by means of an incandescent lamp held for a few seconds before the object-glass. The development of the first plate, in the dark-room of the cellar, was watched with great expectation, and, to the satisfaction of all the bystanders, brought forth two parallel trails, broken into dashes, each representing a second of time, and the whole reticule of the micrometer lines. The first apparatus was soon superseded by a second, and the second by a third, each being improved as the experiments suggested.

Shortly afterward Professor George A. Fargis was attached to the observatory, and at once put in charge of the Ertel transit-instrument. The "photochronograph" in its present shape, and and the improved method of photographing the reticule wires without injury to the star-trails, are entirely his inventions.

The principal idea in photographing the transits of stars is to translate the phenomenon of an object moving over the field of view in a telescope—the instant at which it passes a thread being noted by eye or ear, or by the chronograph—into a picture of the same which can be measured leisurely as a fixed object. The error of the personal equation depends ultimately upon the difference of time required by the eye to receive the impression of a bright object and to let the same go. Impression is more rapid than the letting go, and the relative times of retention vary with individuals, and with the variable physical condition of the individuals. As stars are momentarily occulted behind a thread in transit, this element of retention throws the apparent place of the star beyond the thread; hence eye and ear observations, being taken at intervals *from* the thread, with the star in full vision, are more accurate, and need a positive correction usually to be reduced to transits by chronograph taken *on* the thread.

A photographic plate reduces to a minimum this correction, both as to its amount and its variability; and whatever other corrections may be introduced by the process, they are mechanical and can be obtained by the discussion of results.

For the work of making a standard catalogue of bright stars for fundamental differential comparisons, for longitude determinations, for latitude, and also for physical observations in laboratories. it seems very important to eliminate by some process the error of the personal equation, which is in fact the greatest source of error in all such measures.

The first experiments to determine time by photographs of star transits were made by Professor E. C. Pickering, at the Harvard College observatory, in January, 1886 the account of the work being given in the Memoirs of the American Academy (Vol. XL., p. 218).

The star images of the Pleiades were allowed to trail over a sensitive plate, the eight inch Bache telescope being used, for known intervals of time. It was found that microscope settings on the marks could be made with a probable error of only $0^s.03$, thus indicating the possibilities opened up by the method.

It now remained to apply it to transits in some way available in accurate reductions. There are two steps to be taken: (1) that which should connect the star trail definitely with the astronomical clock; (2) another enabling the transit to be referred to the collimation axis of the telescope. Both must be simple, and free from all important objections. At the suggestion of Professor Pickering and Mr. Willard P. Gerrish, it was, in the summer of 1888, at the Harvard College observatory, attempted to solve the first in the following way. A small plate was attached to the armature of a magnet by which a movement up and down, perpendicular to the star trail through a very small interval, could be communicatad to it by making and breaking the circuit at fixed intervals, either by hand or by the clock, the latter requiring a commutator in which the makes and the breaks should be of equal lengths. The effect was to leave on the plate a pair of dotted lines close together. the dots alternating in the perpendicular direction. The beginnings of the intervals and the endings were definitely marked, and settings of a micrometer thread could be made on them very accurately, the probable error being not greater than $0^s.02$ in second-intervals.

Professor Bigelow constructed an apparatus for testing this process, the plate being kept in a paper-holder inserted in a slide attached to the rocking armature which responded to the currents in the magnet. The telescope used was the eight-inch equatorial and the current was made and broken by hand. In the autumn Mr. Gerrish constructed a commutator by which the clock made the motions of the plate automatically.

Omitting for the moment mention of the second part of the process, for the sake of the chronological order, the next piece of apparatus was constructed by Mr. Saegmüller of Washington, D.C., at the suggestion of Professor Bigelow, and was tried a few nights at the Georgetown observatory in the summer of 1889, by the kindness of the director, the Rev. J. G. Hagen. This piece embodied an important improvement, while retaining the alternating motion of the plate. A frame was made to carry a small plate-holder, which could be very readily interchanged with a common observing eye-piece. The star having been received into the field and adjusted by the direct vision, in five seconds the plate could be placed to receive the transit, this being a great practical improvement, as otherwise the adjustment of the star trail depended upon the finder to the telescope.

The eclipse expedition to West Africa, 1889, withdrew Professor Bigelow's attention from the subject, and further development devolved wholly upon the Georgetown College observatory.

Returning to the second division of the experiment, namely, the referring this trail to the middle wire and thence to the collimation axis of the telescope, without which the observation would be worthless, a number of combinations were discussed at the Harvard College observatory. Professor Bigelow's first experiments consisted in using large threads which should interrupt the star trail by their own occultation of the star. This divided a continuous trail nicely, in two opposing cones of density, and was effective, but had obvious disadvantages for a transit instrument. Finally he found that by shining a light into the objective for two or three seconds, the whole plate could be fogged down without obscuring the dotted trail, which seemed only to advance in its density, while the lines behind the threads failed to be fogged, and, retaining the original density of the unexposed plate, received definite edges suitable for microscopic measures by bisection or parallelism of threads. Small threads, even the ordinary ones used in the transit reticule of observatory instruments, are amply distinct for this purpose, and this part of the process leaves nothing to be desired.

There is no doubt that in a six-inch transit instrument stars can be taken to the fourth magnitude, and wherever the elimination of personal equation is sufficiently important the utility of the method can hardly be doubted. It is believed, however, that the chief field of usefulness will be found in the physical laboratory, where any amount of artificial light can always be used, and the automatic record can be made to assume any degree of accuracy desirable. It is known that many experiments in physics are afflicted with personal equation, and thus there is a hope of avoiding them by the introduction of this apparatus.

NOTES AND NEWS.

THE Boston *Medical and Surgical Journal*, quoting an English medical publication, says that the theory has been more than once advanced that the origin of ether-drinking in Ireland can be traced to the success of Father Matthew's crusade against drunkenness in its ordinary forms. Alcoholic nature, driven out by his eloquence, returned in a new disguise, and the last state of the victims was as bad as the first. This theory has been called in question, but it receives accidental confirmation from what is at present happening in Norway. The sale of liquor is, in that country, encompassed about with more restrictions than that of the most deadly poison is with us. Temperance, in fact, is the law of the land in Norway. But these people, made sober by act of parliament, have now discovered how to get drunk without violating the law. Ether-drinking, according to a Norwegian contemporary, is becoming quite common in certain districts. The farmers buy it in considerable quantities, especially at Christmas time and on other festive occasions, and they treat each other and get drunk on ether, as they formerly did on potato or barley brandy. Ether is said to be drunk by young and old, men and women, rich and poor. If this be true, it seems to point a moral which perhaps thorough-going temperance advocates have not taken sufficiently into account. Is there, after all, a grain of truth in Byron's thesis that "man, being reasonable, must get drunk," and can the moderate use of ordinary stimulants be suppressed only at the risk of the evil spirit, which has been cast out, coming back after the house has been swept and garnished, bringing with him seven devils worse than himself ?

— A correspondent of *Science-Gossip* writes to that periodical as follows: "A friend of mine keeps a quantity of fowls. They are the common kind, usually called, I think, 'barn-door fowls.' On Thursday, April 9, a number of eggs were collected. A few were given to the gardener. His wife boiled one for his breakfast on April 10, and when he cracked it a pin was found in the yolk. The yolk and white were, in places, of a blue-black color. I should feel obliged if any reader would inform me whether they have ever heard of anything being found before inside an egg, and how it got there."

— Bulletin No. 13 of the Experiment Station of the Iowa Agricultural College contains the results of a feeding experiment conducted by the farm and chemical sections. Corn fodder, corn ensilage, sorghum cane ensilage, and mangels were fed for sixty days to eight cows. The milk was sampled at every milking, and the composite samples analyzed every five days. The effect of the four different fodder rations was tabulated and results indicated from the butter fats and total solids produced by each ration, calculated from a dry matter basis. Corn fodder shows slightly better results than corn ensilage, which exceeds sorghum cane ensilage. The mangel ration is superior to any of the others. Clover hay was fed with all the rations, a double amount being given with the roots.

— A simple method of applying concrete under water has been used by the French engineer Heude in connection with the foundation work of the bridge over the River Loire, at Blois. As described in the *Railroad Gazette*, the concrete was deposited at the desired points by means of a wooden pipe composed simply of four boards and being about sixteen inches square in section. This pipe or tube was lowered vertically into the water, and was made of such length that when the lower end reached the bottom the upper end projected about five feet above the surface of the water. By means of suitable lifting tackle and scaffolding the tube could be easily raised and lowered, and moved from place to place as desired. The tube was filled with concrete, and, on being slightly raised from the bottom, the concrete could flow out and spread itself over the surrounding surface without previously coming into intimate contact with the water. By moving the tube about over any desired area, layers of concrete could thus be readily put down varying in thickness from twelve to sixteen inches. The only point to be specially observed was that the level of the concrete in the tube was always above the level of the water on the outside, thus maintaining a sufficient head of concrete to overbalance the tendency of the water to enter at the lower end of the tube. To secure this entire exclusion of water from the tube, the primary filling with concrete was accomplished after having first closed the lower end of the tube with a board; the tube having been filled this board was withdrawn. It is stated that with one such tube about eighty yards of concrete could be deposited per day, and that, in general, the results of the method were entirely satisfactory.

— The winter forcing of tomatoes is little understood by gardeners, and the literature of the subject is fragmentary and unsatisfactory. Yet it is a promising industry for all the older parts of the country, particularly in the vicinity of the larger cities, as winter tomatoes always find a ready sale at good prices. The crop is one which demands a high temperature, an abundance of sunlight, and great care in the growing, but the profits, under good management, are correspondingly high. Tomato forcing is one of the most interesting and satisfactory enterprises for the winter months. Careful experiments upon it during two winters, made at the Cornell University Experiment Station by Professor L. H. Bailey, have met with uniform success. Details of the experiments are contained in Bulletin 28 of the station named, dated June, 1891.

— The Census Bureau at Washington has issued a bulletin on the distribution of population in accordance with altitude. It appears that in the area less than five hundred feet above sea-level is included nearly all that part of the population engaged in manufacturing and in foreign commerce, and most of that engaged in the culture of cotton, rice, and sugar. Between five hundred and fifteen hundred feet above the sea are the greater part of the prairie States and the grain-producing States of the North-west. East of the ninety-eighth meridian 1,500 feet is practically the upper limit of population, all the country above that elevation being mountainous. Between 2,000 and 5,000 feet above sea-level the population is found mainly on the slope of the great western plains. Between 4,000 and 5,000 feet, and more markedly between 5,000 and 6,000 feet, the population is decidedly in excess of the grade or grades below it. This is mainly due to the fact that the densest settlement at high altitudes in the Cordilleran region is at the eastern base of the Rocky Mountains and in the valleys about Great Salt Lake, which regions lie between 4,000 and 6,000 feet. Above 6,000 feet the population is almost entirely engaged in the pursuit of mining, and the greater part of it is situated in Colorado, New Mexico, Nevada, and California. While the population is increasing numerically in all altitudes, its relative movement is decidedly toward the region of greater altitudes, and is most marked in the country lying between 1,000 and 6 000 feet above the sea. The density of population is greatest near sea-level in that narrow strip along the seaboard which contains our great seaports. The density diminishes gradually and rather uniformly up to 2,000 feet, where the population becomes quite sparse. The average elevation of the country, excluding Alaska, is about 2,500 feet. The average elevation at which the inhabitants lived, taking cognizance of their distribution, was 687 feet in 1870; in 1880 it had increased to 739 feet, and in 1890 to 788 feet.

— The following is a brief report of the operations of the Geological Survey of Missouri during June. In the field, examinations of the clay deposits and other structural materials have been continued in Franklin County, and have been extended into Cooper, Morgan, Miller, Callaway, Gasconade, Jefferson, and Ste. Genevieve Counties. Preliminary inspection of coal beds have been made in Ray, Moniteau, Ralls, Putnam, and Grundy Counties, and lead deposits have been examined in Madison County. Detailed mapping has been prosecuted in Madison, Ste. Genevieve, Johnson, Ray, and Randolph Counties, and about 125 square miles have been covered. In the laboratory, analytical work has been done on some twenty samples of mineral waters, forty samples of coals, seven samples of limestone, and fourteen samples of clays. For the solution of problems of general stratigraphy and for the preparation of the report on the paleontology of the State, sections have been visited and collections have been made in Greene, Jasper, Newton, Lawrence, Ste. Genevieve, St. Louis, Clark, Marion, Pike, Lafayette, Saline, and Cooper Counties; and collections have been examined in Kansas City, Curryville, Sedalia, Clinton, and Springfield, Mo., and in Chester and Sparta, Ill., and in Burlington, Iowa. In the office, Bulletin No. 5 has been prepared, and is now in the hands of the printer, and much progress has been made in the preparation of the manuscript of Bulletin No. 6, which will consist of a preliminary report of the distribution of coal in the State. Mr. Frank L. Nason, late assistant geologist of the New Jersey Geological Survey, has been appointed to a similar position on the Geological Survey of Missouri, and will be in charge of the iron ores of the State. Professor Erasmus Haworth has resumed work for the summer on the crystalline rocks, and will also collect material for the preparation of a report on the mineralogy and petrography of the State. Professor C. H. Gordon has similarly resumed work for the summer in the coal fields, and most of his time will be given to the detailed study and mapping of the coal beds of Macon County. Professor J. E. Todd of Tabor, Iowa, has been engaged to take up during the summer the study of the quarternary deposits of Missouri, and to prepare a report thereon.

— The London *Journal of Education* intimates that M. Bourgeois, the French Minister of Public Instruction, is a bold bad man who has dared to run a tilt against the orthodox national spelling. In a circular addressed to rectors, he calls their attention to the waste of time that takes place in many schools in mastering the minutiæ of spelling, to meet the real or supposed exigencies of examiners. To lighten the burden of scholars and teachers, he lays down certain regulations for the future guidance of examiners. (1) Wherever authorities differ, admit all varieties — *rhythme* or *rythme*, *collège* or *collége*. (2) Where the accepted spelling is illogical, do not be severe on the logical pupil — e.g., the plurals in *x* like *genoux*, *apercevoir*, and *apparaître*. (3) Show the same indulgence with regard to the distinctions of recent grammarians — the plural of *cent* and *vingt*, the plurals of compound substantives, the agreement of *demi*. M. Bourgeois is no advocate of phonetic spelling, but he preaches a wide toleration. English spelling is far more anomalous and illogical than French. Is it too extravagant to hope that a similar instruction will be issued to inspectors from the education department, and that the reform may be spread to the civil service commissioners? There can hardly be any more demoralizing study than learning by heart the list of verbs in *-cede* and *-ceed*, and nouns in *-ence* and *-ense*. It is high time that this "fetish of orthography," to which our ploughboys and young officers are equally sacrificed, should be demolished. May we hope, too, that in time the revolution may affect the teaching of French, and that English schoolboys will not be required to know more than is demanded of natives? This, however, is a far-off divine event, and the French examiner for the joint board, or the London matriculation, will fight to the death for his *travails* and *œils*, his *mil*, *mille*, and *milles*, his *gardefu* and *gardeschasse*.

— A new botanical club has just been organized in Canada called the Botanical Club of Canada. The object of the club is to adopt means, by concerted local efforts and otherwise, to promote the exploration of the flora of every portion of British America, to publish complete lists of the same in local papers as the work goes on, and to have lists collected and carefully examined in order to arrive at a correct knowledge of the precise character of the flora and its geographical distribution. The following is a list of the officers for 1891–2: President, Professor George Lawson, Halifax; secretary and treasurer, A. H. Mackay, Halifax; secretaries for the provinces: Ontario, Professor John Macoun, Ottawa; Quebec, Professor D. P. Penhallow, Montreal; New Brunswick, George U. Hay, St. John; Nova Scotia, E. J. Lay, Esq., Amherst; Prince Edward Island, Francis Bain, Esq., North River; Newfoundland, Rev. A. C. Waghorne, New Harbour; Manitoba, Mr. Burman, Esq., Winnipeg; Alberta, W. H. Galbraith, Esq., Lethbridge; British Columbia, Dr. Newcome, Victoria.

— Professor H. Garman, entomologist and botanist of the Kentucky experiment station, reports in Bulletin 31 of that station a series of experiments in the application of Bordeaux mixture to strawberry plants for the prevention of leaf-blight, from which he draws the following conclusions: (1) Injury from strawberry leaf-blight can be largely prevented by the use of Bordeaux mixture and *eau celeste*, and to some extent by potassium sulphide and London purple. (2) Bordeaux mixture is much superior to the other preparations used. (3) Applications of Bordeaux mixture should be made as often as once in two weeks. From the complete exposure of the leaves to rain, the mixture is removed from strawberry leaves much sooner than from grape leaves or those of trees. (4) Prepared according to the following formula, it may be sprayed without the slightest injury to leaves: Bluestone, 6½ pounds; lime, 3¼ pounds; water, 22 gallons. (5) Twenty-two gallons of the mixture is sufficient for spraying during one summer 337½ feet of strawberry plants, as commonly planted in rows; and will cost for materials, considering bluestone worth eight cents per pound, and lime worth one cent per pound, fifty-six cents. By buying materials in quantity, this cost can be reduced. (6) A removal of the blighted leaves in summer, without subsequent spraying, will increase instead of diminish injury from blight.

— The following notes on the home mixing of fertilizers, taken from the annual report of the Maine experiment station, are as applicable to some other states as to Maine. The mixing of fertilizers on the farm through the use of chemicals and raw materials does not seem to have been undertaken to any extent by Maine farmers, although it is clearly shown that intelligent farmers of other states, Connecticut for instance, are finding it profitable to adopt this method of obtaining commercial manures. During the year 1887 and 1888 the Connecticut experiment station examined twenty-one fertilizers mixed by farmers from chemicals purchased by themselves, and the analyses show: (1) That these home mixtures compared favorably in composition with the best factory-made fertilizers. (2) That the home mixtures had a satisfactory mechanical condition. (3) That the ingredients of the home mixtures cost the consumers on an average from 20 to 25 per cent less than if purchased in factory-made fertilizers, after allowing $3 per ton for the cost of mixing. It is not claimed that all farmers would find it profitable to mix their own fertilizers from chemicals, but it is believed that there are many farmers in the State so situated with reference to markets and transportation that they could buy and mix chemicals with profit. This could be better done, perhaps, by an association of farmers, so that by the purchase and transportation of large lots at one time, a saving could be made in prices and freights.

— A new medical sect has arisen in the West, and has already founded a college in the State of Washington, in which medicine is taught according to the biochemic doctrine, which according to the Boston *Medical and Surgical Journal*, is thus described by one of the lecturers at a recent meeting: "The innumerable cells of the human body are supplied by twelve mineral salts in the blood, which, when their proper proportion is interfered with in any manner, cause diseases of different natures, according to which mineral salt is deficient or in excess of its natural ratio; that is, the disturbance of this ratio puts the human system into a proper condition to absorb the disease germs that are constantly floating in the air. By providing twelve specific medicines by which the proper proportion of mineral salts is restored, health is regained and disease driven out by furnishing direct to the blood the same molecules that a perfect digestion and assimilation would furnish. The doses administered supply to the tissue cells the special salt, the lack of which is the cause of all diseases. Under the advance of biochemistry it has become possible to apply to each kind of tissue its own definite and peculiar salt, according to the requirements in disease. By the distinctive systems our physicians are guided in the choice of the particular cell-salts required, the immense variety and numerous complications of morbid states offering vast scope for exact medical practice wherewith to build up the great pyramid of scientific medicine of this advanced era."

— An interesting account of the nest and eggs of the cat-bird (*Ailurœdus viridis* Latham), says *Nature*, is given by Mr. A. J. North in the latest number of the Records of the Australian Museum (vol. i., No. 6). The habitat of the cat-bird is the dense scrubs of the coastal ranges of New South Wales. Although the bird is common, authentic specimens of its nest and eggs seem to have been unknown until lately. For an opportunity of examining such specimens, Mr. North is indebted to Mr. W. J. Grimes, an enthusiastic oologist, who recently secured two nests of this species on the Tweed River. The nest is a beautiful structure, being bowl-shaped, and composed exteriorly of long twigs, entwined around the large broad leaves of *Ptarietia argyrodendron*, and other broad-leaved trees, some of the leaves measuring eleven inches in length by four inches in breadth. The leaves appear to have been picked when green, so beautifully do they fit the rounded form of the nest, one side of which is almost hidden by them. The interior of the nest is lined entirely with fine twigs. The eggs are two in number for a sitting, oval in form, being but slightly compressed at the smaller end, of a uniform creamy white very faintly tinged with green, the shell being comparatively smooth and slightly glossy. Although the cat bird is usually included in the family of bower-building birds, Mr. North has never known or heard of its constructing a bower.

— The following memorandum, by Sir George Birdwood, on the myth of the second birth of Dionysus, as connected with the development of Phœnician commerce and the country of the cinnamon tree, is taken from Louis Dyer's "Studies of the Gods in Greece," 1891: Herodotus (iii. 111) says, "Some relate that it [κιννάμωμον] comes from the country in which Dionysus was brought up;" and (iii. 97), "The Æthiopians boardering upon Egypt, . . . and who dwelt about the sacred city of Nysa, have festivals in honor of Dionysus;" and again (ii. 46) he says, "But Dionysus was no sooner born than he was sewn up in the thigh of Zeus, and carried off to Nysa, above Egypt, in Æthiopia." Now there are several Nysas. Herodotus meant Nysa in Æthiopia, that is the Troyloditic country beyond the Soudan; for the Soumali country is the cinnamon country. On the other hand, the story of Dionysus, "the Assyrian stranger," is, *inter alia*, a myth of the development of Phœnician commerce, of which wine was everywhere throughout the eastern Mediterranean (Levant) the staple; and the Greek myths, associating the wine god with Mount Meroe, in Æthiopia, probably arose from the fact that, in the original Phœnician myth, he was not a "child of the womb," but "of the thigh" (μηρός). That is to say, these myths probably arose at the time when kinship among men had ceased to be traced through their mothers, and had already begun to be traced through their fathers. Similarly, the association of the wine god with "Nysa above Egypt" was presumably due to there having been a Nysa near Meroe, and to his Greek name being Διόνυσος, this Greek form of his name being probably a folk corruption of his Phœnician name, which would almost certainly end in nisi "man." Of course, the cult of the vine and the manufacture of wine did not arise in Æthiopia, but on the slopes of the Indo-Caucasus; and hence Mount Meroe [Meru] and the Indo-Caucasian Nysa have been identified as the seats of the education of the young Διόνυσος.

— Edward Burgess, known the world over as a designer of fast yachts, died at his home in Boston, July 12. Mr. Burgess had been ill since May, the first trouble being typhoid-fever, but it was hoped that he was on the fair road to recovery, when an unexpected ill turn resulted in his death. To the scientific world Mr. Burgess was known as a prominent entomologist. For many years he was secretary of the Boston Society of Natural History. He was much liked by all who knew him, and his record as a yacht designer has been most honorable.

— M. Maspero has an interesting article on the dog in ancient Egypt in a recent number of *La Nature*, a brief synopsis of which we find in *Nature*. It is illustrated by representations of dogs reproduced from Egyptian monuments, and by a mummy of a dog recently opened and sketched by M. Beckmann. In ancient Egypt, as in modern Europe, the dog was regarded both as a friend and as a useful servant. He also received the honors of a god, and there are cemeteries of dogs (corresponding to the cemeteries of cats) where mummies have been found by the thousand. Attempts have been made to identify the various species of dogs represented in wall paintings, but those naturalists who have investigated the subject have not always arrived at the same conclusions. M. Maspero points out that mummies supply more trustworthy materials for study, and urges that men of science should lose no time in examining some of them, as cemeteries of animals are being very rapidly "exploited"

— A recent number of *Nature* informs us that there has been lately formed in Berlin a "Union of friends of Astronomy and Cosmical Physics," with the view of organizing practical co-operation in these subjects of research in Germany, Austria, Hungary, Switzerland, and neighboring countries, and also in the colonies, and where membership may be desired. The object is to be sought by means of free communications of the members or groups of members to headquarters, whence advice and results of observations, etc., will be issued. Sections are formed for observations (1) of the sun; (2) of the moon; (3) of the intensity and color of starlight and of the Milky Way; (4) of the zodiacal light and meteors; (5) of polar light, terrestrial magnetism, earth currents, and atmospheric electricity; and (6) of clouds, halos, and thunderstorms. Professor Lehman-Filhés has been elected president of the Union, and the presidents of the sections are Messrs. Förster, M. W. Meyer, Plassmann, Jesse, Weinstein, and Reimann.

— The work done by university extension students at Cambridge last year was so satisfactory, according to *Nature*, that the syndicate for local lectures are encouraged to repeat the experiment this year. They will be prepared to receive a larger number of students, say from sixty to eighty, most of whom will be lodged either at Selwyn College or at Newnham College. The period of study will last from July 28 to Aug. 22, or nearly a month in all. The syndicate have just issued a detailed programme of the various courses of study; and due attention has been paid to the claims of science as well as to those of literature and art. At the chemical laboratory, on alternate days, there will be a course of demonstrations illustrating the methods of chemical manipulation in a short series of typical experiments. The pupils will be first shown each experiment, and will then be expected to repeat it for themselves. At the Cavendish laboratory, on alternate days, a course of short experimental lectures, chiefly on electricity and magnetism, will be delivered; and most of the experiments shown in the lectures will afterwards be performed by the students for themselves. Geology will be studied, on alternate days, at the Woodwardian museum, where there will be a course of demonstrations on the leading fossil types of the animal kingdom, from the specimens in the museum. A course of demonstrations, followed by practical work, will be given, on alternate days, in the physiological laboratory; and Mr. Graham, chief assistant at the observatory, will receive students and explain the uses of astronomical instruments. Arrangements will also be made for taking small parties of students to the observatory at night. Single lectures will be delivered by various eminent Cambridge men, and in this part of the work science will be represented by Professor G. H. Darwin, who will lecture on the history of the moon or some allied subject. It may be noted that the students in science will be allowed to read in the Philosophical Library.

— William Weber, the illustrious physicist, died at Göttingen on June 23.

— The biological laboratory of the Brooklyn Institute, located at Cold Spring harbor, Long Island, opened for its second season of instruction on July 1, with a full complement of teachers and scholars. Of these latter the greater number are professors and advanced scholars in the various colleges and schools of Brooklyn, New York, and vicinity. The success of the biological laboratory has been due in great measure to the efforts of Professor Franklin W. Hooper, the curator of the Brooklyn Institute, who has been heartily aided by Fish Commissioner Eugene G. Blackford and Mr. John D Jones, as well as a large number of interested Brooklynites and residents at Cold Spring.

— At the last meeting of the Board of Trustees of the University of Pennsylvania Dr. George A. Piersol was chosen professor of anatomy, succeeding the late Professor Leidy; Dr. Harrison Allen, professor of comparative anatomy, to succeed to Dr. Leidy's chair in the biological school, and Dr. John B. Deaver, assistant professor of applied anatomy. Dr. Edward Martin was elected to the chair of special surgery. In the veterinary department Dr. S. S. J. Harger was elected professor of veterinary anatomy, and Dr. Leonard Pearson, who is now pursuing special studies at the Royal Veterinary School of Berlin, assistant professor of veterinary medicine.

— Last spring, Professor Forbes of Champaign, Ill., State entomologist received from the Smithsonian Institution a few of the larvæ of a parasite supposed to be destructive to the Hessian fly, and said to be found only in Europe. He undertook to experiment to prove whether these larvæ are destructive to the fly here, and if so, in what degree. In order to determine this, a small patch of wheat was inclosed in a box arranged so that the grain could have light and air. A number of Hessian flies and the larvæ mentioned were put in, and the box so closed that they could not escape or other insects get in, and thus the experiment was begun. According to recent reports the larvæ have hatched and are flourishing. They are almost microscopical and seem to have been created solely to prey upon the Hessian fly. The parasite is a neatly-formed, wasp-shaped little mite, supplied with a sharp sting or auger. With unerring instinct it finds the place where the fly has laid its eggs under the husk of the straw, and, boring down into it, the parasite lays its egg inside the egg of the fly. There it develops into a grub, consuming the egg of the fly and destroying it. This is an outline of what has been proved by the experiment made. The parasite was first discovered making its depredations upon the Hessian fly in the wheat-fields of southern Russia.

— The following circular to colleges, dated June 6, 1891, has been issued by the secretary of the Illinois State Board of Health, Dr. John H. Rauch: "There is a demand from medical teachers, and young men that intend to study medicine, for a literary course preparatory to the study of medicine. This demand has been met by a few of the literary institutions in the United States, and it is hoped and believed that it will be much more generally met during the next two years. The following institutions now offer science courses for students that intend to study medicine, or that intend to teach or otherwise engage in biological work: (1) University of Wisconsin, (2) University of Pennsylvania, (3) Johns Hopkins University, (4) University of Notre Dame, (5) Yale University, (6) Cornell University, (7) Princeton University, (8) Lake Forest University, (9) Northwestern University, (10) West Virginia University, (11) University of Kansas. As must be obvious, such a course should be based on biology, and should include thorough work in this science, as well as in osteology, comparative anatomy, and chemistry, with English, French, German, some Latin, clay modelling, free-hand drawing, mineralogy, mathematics through trigonometry, physics, mechanics, logic, general and pharmaceutical botany, and (in the last year) psychology. It is of course understood that botany, being a branch of biology, should have a prominent place in the course. The catalogues of the universities mentioned contain the lists of studies offered in their science courses. Such a course should extend over four years. This will involve no loss or waste of time to the student. The Illinois State Board of Health now requires that students of medicine matriculating in the autumn of 1891, or thereafter, must study medicine four years, and must attend three courses of lectures, no two in the same twelvemonth, in order to obtain a license to practise in Illinois. This rule will apply also in some other States. The Illinois State Board will, however, recognize a thorough course in science, such as indicated above, as equivalent to two years' study and one course of lectures, thus enabling the student to enter the second class in the medical college. This makes the full time of study six years in the literary and medical schools, or two years less than is required of the student pursuing a strictly classical course. Not only will time be thus saved, but the science student will be much better prepared to enter the second course of the medical school than will the classical student to enter the first year. The Illinois State Board wishes to make up a science course that can be recommended to any college wishing to adopt such a course, and having but little time to study the subject, I desire to enlist your aid and have your advice in the matter so as to make the course as practical and as beneficial as possible. Will your faculty, therefore, make out such a course as it thinks best for the purpose, and send it to the secretary of the board? The demand from medical teachers and from students of medicine having been met by some universities, must be met by all that would continue to hold a high rank as educators of young men for the work of life."

— In a note communicated to the French Academy of Sciences, says the *International Journal of Microscopy*, M. A. Lothelier states that in *Berberis vulgaris, Robinia pseudacacia, Ulex Europœus*, and other plants, the formation of spines is dependent on the access of light. Plants grown in comparatively little light present very few spines, but those grown with free access to it have more numerous, more differentiated, and more developed spines. M. Lothelier has observed that the loss of assimilation power caused by the development of spines is usually balanced by the stronger growth of the axillary leaves.

— The skin of toads and salamanders has lately been submitted to microscopical examination by Mr. Schulz (*Intern. Journ. Micros.*), who finds that there are two kinds of glands present in the skin of these animals, viz., mucous, and poisonous. The former are present all over the body; the latter are confined to the back of the body and limbs and the ear region behind the eyes; and in the salamander are present at the angle of the jaw. The poison-glands are larger than the mucous glands in the salamander, are oval, and have a dark granular appearance, due to strongly refractive drops of poison, a good reagent for which is copper hæmatoxylin. The poison is secreted by epithelial cells lining the glands, and, when the animal is stimulated by electricity, it is exuded slowly in drops by the toad, but discharged in a fine jet, sometimes to the distance of a foot or more, by the salamander. The anæsthetic action of the poison of the toad and the use to which it is put in medicine by the Chinese have frequently been pointed out.

— K. Hartmann, in *Gesundheits Ingenieur*, relates a case in which a lead pipe was cut through by an insect that was actually found with its head in the hole pierced by it. A workman was called in to repair a defective pipe which had been injured on a previous occasion, as was reported, by a "nail hole" occurring in a soldered joint. This time the worm (a wood wasp) causing the mischief was found *in situ*. The hole on the exterior of the pipe was of a rounded form, about one-quarter of an inch long by one-eighth inch wide, and the penetration was through the entire thickness of the metal. Though of rare occurrence, says the *Scientific American*, well-authenticated instances of similar injuries by insects are on record.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

PHYSICAL DEVELOPMENT.[1]

GREAT interest has. I am happy to state, been taken in the results already obtained by the Polytechnic Physical Development Society. Their publication at the Leeds meeting of the British Association has caused inquries for further information to be addressed to us from all parts of the kingdom, the continent, India, Africa, and America. I mention this because it shows that the public are beginning to realize that the physique is something more than a matter of great interest to scientific observers; that it is, in fact, a subject of practical importance to each one of us; and that the time is ripe for the formation of an organization to deal with it as a science and an art.

It is, doubtless, pretty generally known that, broadly speaking, the difference in the physique of man in the highest centres of civilization and that of man in a savage — or, to be more accurate, in a lower state of civilization — is, with the exception of parts of the brain, greatly in the favor of the latter; that is to say, we have obtained the advantages of civilization, with the above exception, at the expense of the body; and inasmuch as we are continuously making further advances in knowledge, and applying that knowledge in the ordinary routine of daily life, the tendency of this progress still is to the further detriment of the body. This is not an agreeable fact to contemplate, and the reminder that the "fittest" will survive neither affords us compensation for the injury nor points out the means by which it may be obviated; for the class of the fittest for the circumstances of a generation ago is not the class of the fittest for the circumstances of to-day, and the class of the fittest for the circumstances of to-day will not be the class of the fittest for the circumstances of the next generation. Hence this most important question arises, How can we obtain for civilized man a physique equal at least to that of man in a lower state of civilization, and make the further advances of knowledge tend to the advantage of the body? The answer to this question, I shall show, lies in the ascertainment of the effects of the conditions of our habits and surroundings upon the body, and the application of that knowledge to our own protection and advantage.

Nearly twenty years ago I commenced the investigation of this subject, and the results of that research I laid before the British Association in 1886–87. Then I showed that the size and shape of the chest varied as I varied the conditions to which it was subjected. For example, when I submitted a chest to conditions that tended to develop it, that chest increased in size, and its form or type changed accordingly. When I submitted a chest to conditions that tended to decrease it, that chest decreased in size, and changed its form or type accordingly. I ascertained that those results were absolutely invariable, and could be carried out within such wide limits that, on the one extreme, they embraced the class of the non-survivors, through consumption, and on the other, the finest physique of the class of the survivors or fittest. I pointed out the fact that we had an example of one type of chest forming a series of types that have varied precisely as the conditions to which it was subjected have varied. At birth the male child of all classes has the same type of chest, but at maturity he has that of the class to which he belongs. We have the same relationship between conditions and type; on the one hand, in those who use wind instruments, or who by their occupations require to greatly use their lungs: and on the other, in those who spend a great portion of their time in a stooping position, or who compress their chests either by the instrument they use in their work or by a corset. The great development of the muscles of the trained athlete and the wasted muscles of the paralytic are due to to the conditions of their use and disuse respectively. We know that the head has been altered in shape by direct pressure, and that the greater size and the more complicated arrangement of the brain of a European to that of an aborigine of Australia is produced by the greater mental training of the former. The difference between the hands and fingers of a pianist and those of a man accustomed to lift heavy weights is produced by the conditions of their occupations. Upon the presence and absence respectively of shoes depends the difference in the size and shape of the foot of a Chinese lady and that of a woman in the uncivilized state. The color and thickness of the skin vary according to the conditions to which it is subjected, and there is the same relationship between the size and shape of each part of the body and the conditions to which it is subjected. Therefore, the type of man after birth is solely produced by the conditions to which he is subjected. Hence the formation of race by man's continuance under the same conditions, and its subsequent division into sub-races and families by his migrations into new conditions and the minor differences therein. Hence also the difference between the same species of animals under the conditions of nature and of domestication, between the products of the same seeds when sown in different localities, between the same plants when placed under different conditions, and the return of man, animal, or plant to former types when subjected to the conditions that produce that type.

It would be difficult to overestimate the immense importance of the facts just briefly referred to. They prove to us beyond the possibility of a doubt that man is what his habits and surroundings make him; that he is a member of the class of the survivors or fittest because the conditions, as a whole, of his habits and surroundings are favorable to him;

[1] Godfrey W. Hambleton, president of the Polytechnic Physical Development Society, London, in Physique.

that he is a member of the class of the non-survivors, those who prematurely disappear, because the conditions as a whole of his habits and surroundings are unfavorable to him; and that he can so order his habits and surroundings that they shall tend to his advantage. A great work and a great future lie straight before us. We have to ascertain the tendencies of all the conditions to which our bodies are subjected by our habits and environment, in order to apply that knowledge to our own protection and advantage. And that is the sphere of true physical development.

An important step towards the attainment of this great object has been taken by the formation of a society to apply the principles of physical development in the ordinary routine of daily life. Some twenty-five members joined at the first meeting of the Polytechnic Physical Development Society. Now, thanks to the courteous and cordial co-operation of Mr. J. E. K. Studd and the authorities, upwards of three hundred members have entered their names on the books; and when the society is better known and the great benefits it does confer are recognized, I do not doubt that that number will be considerably increased. At Leeds I gave the results obtained by a hundred members. The average increase of their chest girth was $1\frac{3}{4}$ inches. I divided them into three classes, the average increase of the chest girth of the third class being $1\frac{1}{4}$ inches, that of the second class being $2\frac{1}{8}$ inches, and the first class $3\frac{3}{8}$ inches. There has been a considerable increase in the range of movement of the chest, the average then being, I think, $4\frac{1}{2}$ inches. Hutchinson's standard of vital capacity has been greatly exceeded, and in the power of inspiration and expiration the majority belonged to or exceeded his "remarkable" and "very extraordinary" classes.

At the subsequent examination for the society's gold medals, the first medallist had obtained an increase of the chest girth of $6\frac{1}{2}$ inches, the second an increase of 5 inches, and the third $4\frac{3}{8}$ inches. The society's medals for the best physique were awarded to members who had exceeded Brent's "medium" standard by 3.67 inches, 2.42 inches, and 3.32 inches, and twenty certificates were given to those who had obtained and exceeded that standard.

I am glad to say that increase continues. We have just held our second general annual meeting, and I find the average increase of the chest girth of one hundred members is now two inches, that of the third class being $1\frac{3}{8}$ inches, the second $2\frac{1}{4}$, and the first $3\frac{5}{8}$. That increase has taken place in small as well as in large chests, whether the men were tall or short, under or over twenty-one years of age, and with or without previous gymnastic training. Our members are engaged from eight to twelve or fourteen hours daily in over fifty different trades and occupations, amongst them being clerks, compositors, printers, watchmakers, carpenters, engineers, drapers, warehousemen, etc. The variations in the chest girth and vital capacity that have taken place are most instructive. I have frequently noted a large decrease when the members were training too much in the gymnasium, or engaged in extra work, stock taking, cycling, and when they neglected to follow the directions given them. In fact, the increase or decrease observed has been in direct relationship with a corresponding change in the conditions of their habits or surroundings. It is satisfactory to note that the number of chest girths of from 38 to 40 inches and upwards is steadily increasing. We have also many members who have nearly attained Brent's "medium" standard, which is 5.40 inches above the average of the artisan class, and 3.17 inches above that of the most favored class. The importance of these facts will be seen when it is borne in mind that this is a new society, carrying new principles into practice, that its members are placed under more or less unfavorable conditions, that it is purely voluntary, and that its members leave us when they leave the institution.

Perhaps the best way to explain the practical work of the society is to describe what happens to a new member on joining it. He is placed in an erect position, his shoulders are brought well back, and his clothing so loosened over the whole of the chest that it permits full and free movement. I find in nearly every case the clothing is from one to two inches or more too tight. Then he is shown the simple movements that are necessary to throw the weight of the shoulders on the spine, he is taught to inhale and exhale deeply through the nose, and to use the spirometer and manometer. We explain to him that the conditions of his habits and surroundings tend either to his injury or to his advantage. He is told to avoid those that tend to act injuriously, and where that is not possible or practicable, to ascertain their amount and to counteract their effects, and to place himself under those that tend to his advantage. We request his careful attention to these conditions, and deal first with those that have to be avoided. The habit of stooping, positions that cramp or impede the full and free movement of the chest, or a faulty carriage of the body, are very injurious. Habits that tend to the disuse of the muscles or to their excessive use are to be avoided. Breathing through the mouth, or breathing air that has a temperature much above that of the external air, or that is impure, or that contains dust, is very injurious. Wearing tight-fitting or too heavy clothes, braces, corsets, or shoes with high heels and narrow toes, tends to impede the full and free movement of the body and is injurious. And whatever of his habits or surroundings tends to act injuriously or to produce such acts must be avoided.

We tell him to acquire the habit of holding the body erect, the shoulders back, and the chest well forward; to breathe through the nose, and to take deep inspirations followed by full expirations several times daily; to develop the muscles, especially of the chest, by gymnastic exercise on Ling's system; to go in for the daily tub or swimming; and to have the clothes made quite loose at full inspiration, and to se that they do not impede either by their weight or shape the free movement of the body. We advise him to live in rooms that are in free and direct communication with the external air night and day, summer and winter, and to take care that their temperature is not too high; to spend as much time as possible daily in the open air, and to maintain the temperature by muscular exercise. We point out to him that walking is a most healthy exercise, and that broad toes and low heels tend to promote it. We tell him to practise singing, and to take advantage of some form or other of athletics whenever the opportunity presents itself. And whatever of his habits or surroundings tends to his advantage or to produce acts having that tendency must be adopted.

We are all of us at times subjected to unfavorable conditions that we cannot, under present circumstances, avoid. For example, it would be difficult to be present at any public meeting in a large building without having to inhale both impure and overheated air. But when we have obtained a certain amount of physical development, a few deep inspirations followed by full expirations in the open air will be sufficient to counteract that. Again, the occupation or business in which we may be engaged may necessitate a somewhat cramped position of the chest, but on leaving, a trained man will soon obtain compensation for that by holding the body erect and taking proper breathing exercise. The main point is to ascertain our unavoidable injurious conditions, and to arrange the other conditions so that the tendency of the whole is decidedly in our favor, and it will take a well-developed man — and by that I mean a man having a physique between Brent's "medium" and "maximum" standards — but little time and trouble to accomplish that. These directions are very simple, easy to carry out, and in one form or other are within the power of each one of us. But they effect a complete change in the conditions to which the body is subjected, and to make that change with safety it must be slowly, gradually, and uninterruptedly effected.

I will now point out some cases in which physical development is urgently required, and where its adoption will render an immense public service. Take the case presented by the army. Considerable attention has recently been directed to the large amount of inferior physique that is present in the ranks. On the 1st of January, 1889, the army numbered 202,761 men, but of these there were 82,979 whose chest girth was under 36 inches, — that is, from 31 inches up to 36 inches, — and only 16,324 who had a chest girth of 39 inches and upwards. Now on Brent's "medium" standard there ought to have been none under 36 inches, and 67,236 ought to have had a girth of 36 inches and upwards. There is, however, another mode of showing the presence of this inferior physique, and that is by the great liability of the army to disease under ordinary circumstances. During the year 1888 there were 193,233 admitted into hospital, 1,845 died, 2,078 were sent home as invalids, 2,776 were discharged as invalids, and 10,715.97 were constantly non-effective from sickness. It is obvious that had the men been of good physique, and subjected to fairly good conditions, there would not have been anything like this serious amount of sickness, invaliding, and death. Why should not these men be placed in a position to successfully compete with the unfavorable conditions of their surroundings by the introduction of physical development?

A reference to the tables in the supplement to the Registrar-General's report, showing the comparative mortality of those engaged in different trades and occupations, will show the necessity for the diffusion of the knowledge of physical development amongst those engaged therein. Life assurance and sick benefit societies would not only considerably add to their incomes and increase their stability by the recognition of this relationship between conditions and type, but they would also by that very act become powerful agents in the promotion of national physique and public health.

The introduction of physical development as a necessary part of the education of children is urgently and imperatively demanded. They have a splendid type of chest at birth, the proportion of chest girth to height being a little above Brent's "maximum" standard, but under the present system of bringing up children, they are, from the moment of birth, right through the whole course of modern education, submitted to unfavorable conditions, so that for a height of 51.84 inches there is a chest girth of 26.10 inches, instead of one of 35.18 inches, or a loss in about ten years of nearly nine inches. Here you have the best standard of chest girth. Is it too much to ask that the conditions of the child's surroundings, as a whole, shall be so arranged that it may be retained? Look at the poor, puny chests we meet with everywhere, and at the reports of the Registrar General, and then we shall see the grave responsibility that lies upon us for producing such a change and permitting it to continue.

The cases just noted evidently require the introduction of physical development, but where shall we find a man, a woman, or a child in civilized countries upon whom its adoption would not confer a great benefit? We are here face to face with a work so great that it will require all the intelligence, the energy, the influence, and the means of a well-organized body to accomplish it. The workers are here, an important section of the public is ready to co-operate, and the time for action has come. Why should we not have a national association to meet this great national want?

CONTAMINATED WATER SUPPLY FOR LIVE STOCK.[1]

THERE is no fact better known to the sanitarian than that one of the chief sources of danger to life and health is the contamination of drinking water. If a malignant form of fever makes its appearance in a family, which cannot be explained by the history of actual exposure to contagion, the water supply always comes in for an early and liberal share of attention. The instances are sufficiently numerous in which the investigator is enabled to trace the malady to this source, to warrant every reasonable precaution in procuring a pure water supply. Nor are these facts known to the sanitarian alone. The reading public have been sufficiently enlightened on this subject to enable them to avoid much of the danger from this source.

While we are beginning to take a fairly lively interest in our personal dangers and the methods calculated to avert them, we have yet hardly taken time to consider the economic question of how far our live-stock industry may be affected by the same class of causes. We drill down into the solid rock to procure a water supply of unquestioned purity for family use. We boil, or subject to other purifying means, all suspected samples before they can be used. This is well. But all this time our helpless dumb creatures may be compelled to drink from a shallow slough, foul with decomposing vegetation, or from a surface pond almost at boiling temperature under a summer sun, where the minute forms of animal and vegetable life generate in such profusion as to render the whole a mass of animate slime.

No one who has had a glimpse of the microscopic world would expect a human being to take a draught of such a beverage and live. But our animals are not only expected to live, but to thrive under such conditions. That these expectations are frequently disappointing, I will cite an instance or two in proof. During the latter part of the summer of 1890, I had occasion to investigate a severe outbreak of disease on a farm in one of the counties of Iowa. The animals, including horses, cattle, and pigs, were all affected in the same way. The local symptoms were largely confined to the throat. There was a swelling, partial paralysis of the walls of the air passages, and painful and difficult breathing. The animals attacked uniformly died after an illness of about two days. The disease I could not recognize as belonging to any of the well-defined types with which I was acquainted. Here were horses, cattle, and pigs sick and dying with disease showing the same symptoms in all.

There are few if any of the specific forms of disease that spread, as epizootic, among the widely differing species of domestic animals. I could not classify the disease, and at once set about the task of discovering, if possible, some common source of exposure. The pastures, buildings, and water supply were each in turn subjected to careful scrutiny.

[1] M. Stalker, in the May Bulletin of the Iowa agricultural experiment station.

The buildings were such as are to be found on ordinary Iowa farms, fairly comfortable and clean. I could find no clue in the quantity or quality of feed that promised to lead to a solution of the difficulty.

On investigation of the water supply, I found that most of the animals on the farm drank from a small creek that ran a zigzag course through the premises. The stream was in part supplied from a series of springs, and in ordinary seasons afforded a fair amount of water, which ran, at least for a portion of its course, over a gravelly bed. The dry summer of 1890, with several previous ones showing an abnormally light rain fall, had so reduced the amount of water that it had ceased to run. On making examination and conducting inquiries, I ascertained that it had been the custom on the farm to throw the carcasses of animals down the steep bluffs into the bed of the stream. I further learned that during the summer, chicken cholera had prevailed on the farm, and that a large number of chickens had died and been thrown over the bank. I was also informed that the hog-cholera had caused the death of a considerable number of swine, the carcasses having been treated in a similar manner. The several yards occupied by horses, cattle, pigs, and barn-yard fowls were on the hillside, with abrupt drainage into the creek. In addition to this, large heaps of fermenting manure were deposited about the foot of the hill, near the edge of the stream where the animals went to drink.

A few of the animals on the farm had not had access to the stream, but had been watered from a well. None of these had showed signs of sickness, though they had been in daily contact with those that had their water from the pools in the bed of the stream, and even with some of the sick. On looking up the local geography of the neighborhood, I found that a number of farmers had built their homes along the banks of this stream, and had been accustomed to make use of it in much the same way as the farmer above referred to. Inquiry elicited the fact that on no less than four farms situated on the banks of this stream, animals had died showing symptoms identical with those on the farm first investigated. I regarded the evidence as sufficient to make out a strong case against the impurity of the water, and gave an opinion accordingly.

The above is but a single instance out of many that have come under my observation. It is one of the most glaring, but by no means one attended with the greatest degree of loss. On another occasion where a high rate of mortality had prevailed among the cattle running on the open prairie, I was able to trace the cause to contamination of surface water. An animal, dead from anthrax, had been drawn into a basin on the open prairie. Later the rains filled the basin with water, and about one thousand cattle on the range had access to the pond for water supply. The result was that about ten per cent of all the animals having access to the impure water died from anthrax. The teachings of these object lessons are sufficiently obvious. These animals are endowed with organizations not unlike our own, and the manifest laws of being and of health can no more be violated with impunity by them than by ourselves.

THE LAST ENGLISH HOME OF THE BEARDED TIT.[1]

IN the memoir of the Geological Survey of the country round Cromer [England], is a rough sketch-map of the outline of the north-west corner of Europe as in all probability it existed at the newer pliocene period, in the far-off days when the primitive vegetation and monstrous creatures of a still earlier world were slowly giving place to plants and animals of "more of the recent" types.

A great river, since dwindled to the insignificant Rhine, with its mushroom castles and ruins, swept through fir woods and swamps to an estuary hemmed in to the westward by a coast-line unbroken, excepting here and there by a tributary stream, to John o' Groat's, rolling down in its sluggish current stumps of trees, and bones of elephants and bears and beavers, to be washed long ages afterwards from the "forest-beds" of Sheringham and Runton. The swamps through which the old estuary once cut its way lie buried now in places a hundred feet or more deep, beneath Norfolk turnip fields and pheasant coverts.

The fens of the Great Level, which, before Dutch drainers and dyke-builders had reclaimed the second Holland, were perhaps their nearest counterpart in the England of human times, are scarcely less things of the past. The marsh devils, which, until St. Bartholomew interfered and drove them off with a cat-o'-nine-tails, held open court there, and, as Matthew of Paris tells in his "Greater Chronicle," came out in troops to maltreat the few hardy Christian settlers, who, like St. Guthlac, as penance for past wild lives, sought holy retirement there — dragging them, bound, from their cells, and ducking them mercilessly in the black mud, "*cœnosis in luticibus atræ paludis*" — now cower invisible in the ditches, or sneak out as agues, to be ignominiously exorcised with quinine. Hares and partridges have taken the place of spoonbills and bitterns, and ruffs and reves; and, where a few years ago wild geese swam, ponderous Shire cart-colts gallop, scarcely leaving in summer a hoof-mark on the solid ground.

The old order almost everywhere has changed and given place to new. But there is a corner left — the district of the Broads of Norfolk — where one may still see with natural eyes what the world in those parts must have looked like in days before the chalk dam which connected England once with the mainland was — happily for Englishmen of these days — broken through, snapped by a sudden earthquake, or slowly mined by countless generations of boring shellfish, until it gave way under the weight of the accumulating waters of the estuary, choked to the north by advancing ice, or tilted westward by some submarine upheaval. There, with a very small stretch of imagination, one may still hear mastodons crashing through the reed-beds, and British hippopotamuses splashing and blowing in the pools; and, as every now and then an incautious footstep breaks through the raft-like upper crust of soil, and imprisoned gases bubble up, one may, without any stretch of imagination, smell the foul stenches of pliocene days.

The climate in those days, geologists tell us, judging by the fossil plants of the time, must — before the country was wrapped in ice — have been much what it is in Norfolk now. "If the various sections of the upper fresh-water beds are examined, we find," writes Mr. Clement Reid, who surveyed the country round Cromer, where the forest-beds are most exposed, "that all appear to have been formed in large shallow lakes like the present broads, or in sluggish streams connected with them."

Three considerable rivers, the Bure, the Waveney, and the Yare, after meandering through level meadows and marshes, — none of the three, according to Sir John Hawkshaw's estimate, with a fall of more than two inches in the mile, — join and meet the full strength of the tide in Breydon Water. The outflow is checked, and the volume of the streams, finding no other way to dispose of itself, has spread out into side-waters and back-waters, wherever the law of levels, the only law to which it owns allegiance, has admitted the right of way.

The result is a triangle of some fifteen or twenty thousand acres or more in which — as in the abyss through which Satan winged his way in search of the newly created world,

> "Where hot, cold, moist, and dry, four champions fierce,
> Strove for the mast'ry"—

land and water hold divided empire. In places the water seems at the first glance to be carrying all before it. Broad sheets (some of them a hundred acres or more) spread almost unbroken surfaces over unfathomable depths of mud. But the encircling rings of rushes, dwarf alders, and other multitudinous marsh plants,

[1] T. Digby Pigott, in the Contemporary Review for July.

creep in insidiously, each generation growing rank and dying to make soil on which the next may find a footing for another step inwards.

The water revenges the encroachment by flooding the land wherever it finds a chance, and undermining when it cannot overflow, till it is impossible to say where the one begins and the other ends. One walks almost dry-shod across what had seemed a dangerous pool, and the next moment sinks over one's fishing stockings in what anywhere else would have been dry land. The confusion of ideas as to the relative solidity of earth and water which results from an hour or two spent in exploring a soft "broad" marsh is not lessened as one sees the huge brown sail of a "wherry" —the craft which is said to go closer to the wind than any other afloat — moving straight up to one, to pass by at eight or nine miles an hour, sailing to all appearances on dry ground. The navigable channels are most of them natural cuttings in the dead level of the marsh, invisible at a very few yards' distance.

The name of the long pole, which is one of the most important parts of the equipment of the Norfolk wherry, the "quant," is, by the bye, a memorial of the days of Roman occupation. It was with a quant, spelt a little differently in Virgil's day, that Sergestus, in the immortal boat race, tried to shove off his galley when he had cut his corner too finely and run aground; and with a quant that Charon ferried his passengers across the Styx: —

"Ipse ratem conto subigit velisque ministrat."

The entire district is unlike anything else in England, and, apart from its power of recalling the past, has an exceptional interest of its own for naturalists. It is the paradise of shy creatures of all sorts, birds especially, which love mud, or water, or reeds; and has been the last settled English home of more than one rare species. Their number, in spite of the keener interest taken of late years by land-owners in bird preservation, steadily decreases.

The avocet, with its spindle shanks, and beak turned up like a shoemaker's awl, which not very long ago bred so freely in the salt marshes that "poor people made puddings and pancakes" with their eggs, is now the rarest accidental visitor. The bittern, comparatively lately a regular breeder there, no longer "guards his nest" among the sedges and reeds; and ruffs and reeves are as rare as they once were common. But there is — or at least till last year was — one little bird, which, driven from every other part of England, has made the broads his own peculiar property, and himself thoroughly at home there. Hardy and modest in his wants, the bearded tit has been essentially a home-staying bird. His ancestors seem to have elected, generations ago, that, whatever the advantages of a winter in Algeria, the disadvantages were greater, and that, on the whole, it was better to face the evils that they knew than fly to others that they knew not of.

The "developments" of the family ever since the decision was made have been in a direction to fit them for a quiet life among the reed-beds. Other birds, smaller even than they, whose forefathers were of a different opinion, have wings now so perfected that, when soft animal food fails in England, they think nothing of a flight of a few hundred miles to a sunnier spot where fat insects may still be found.

The bearded tit, with his little round wings and the heavy canvas of his long tail, cannot do what they can. But he can do what they cannot, and make the most of what is to be got in the way of food at home. In the swampy grounds from which his reed beds grow are quantities of very small snails. Some early ancestor, feeling the pinch of hunger, ventured experimentally to pick one up and eat it, and finding out the sustaining qualities of the rich inside meat, brought up his young ones to eat them too, and make light of the aches which a sharp-edged, hard shell swallowed whole must have caused in a delicately-coated stomach.

They, in their turn, brought up their young on the same Spartan system, and now — unlike other tits, which have most, if not all, of them tender insides, suitable enough for digesting soft insects, but unfit to do justice to anything harder than a seed well steeped in gastric juice – the bearded tit finds himself the possessor of an honest, study gizzard, which can grind up, without the least inconvenience to the owner, any number of the shells of the snails which are its chief delicacy. As many as twenty little snail-shells have been taken from the crop of one bearded tit.

We wonder now why good people should have been so much alarmed as once they were at the doctrines of "development." It is the teaching of the Parable of the Talents extended from the spiritual to the physical world, — powers neglected or abused withdrawn, others well used increased.

The shape and color of the bearded tit are as specially adapted as is its stomach to the peculiarities of its surroundings Visitors to the broads in midsummer who may have caught glimpses of the bird, showing itself for a minute or two at a time, a conspicuous object against the green of the young rushes, may find it difficult to realize that the bearded tit is, when invisibility is of most importance to it, protected by color and form scarcely less perfectly for all practical purposes than are leaf-insects, or stick-caterpillars, or the wonderful creatures described by Professor Drummond in his "Tropical Africa." But such is the case. The eggs are laid about the middle or end of April, when the tall reeds, among which the nest is built an inch or two from the ground, are ripe for cutting

The prevailing tints of the entire district — land, water, and sky — are then the cinnamons, straw-colors, and pale blue greys, miraculously reproduced in the feathers of the bird, which might pass for the emancipated spirit of the dead reeds of last summer. The long tail, with its pointed end, hangs down as its owner comes in sight for a moment to look about him, the counterfeit presentment of a faded frond of the stalk he grips, one foot above the other.

The hoopoes, as the legend goes, wear their crown of feathers in memory of the day when their ancestors saw King Solomon almost fainting under a sudden burst of noonday sunshine, and sheltered his royal head with a parasol of overlapping wings. It may be as a mark of approval of the manliness with which he faces winter on the broads, when snipe and other birds have been driven off by the cold, that the bearded tit now wears the long silky black moustache — his own peculiar adornment — which hangs from each side of the beak. As in the nobler species, the moustache is noticed only in the males. There is a prolongation of the cheek feathers of the female also, but not the same contrast of colors.

For all ordinary winters the bearded tit is amply provided. But, unhappily, last winter — the longest on record since the days of Lorna Doone — was not an ordinary one. Fifty-nine days of consecutive, almost sunless frost were recorded in London, and in parts of the broads the weather was even more severe The snails for weeks and months must have been glued fast to the ground or rush-stalks, — tantalizingly in sight for much of the time, as there was no great quantity of snow, but as much out of reach of a small beak as flies in amber. The birds when most in need of a warming meat-diet were driven to depend almost entirely on such dry ship-biscuits as the seeds of reeds, without even water, except here and there in the running streams, to wash it down, and have suffered terribly in consequence.

It was on one of the bright mornings towards the end of April last, when, in spite of a wind still nailed in the east, a warm sun, and such spring sounds as the call of the nut-hatch, — a pair of whom had from daybreak been carrying on a lively conversation over an unfinished nest in a box in the garden, — encouraged the hope that the return of the glacial epoch might not after all be so near as for the last six months had seemed probable, we found ourselves, after an early breakfast and drive of fourteen miles, landing from a boat on the edge of a marsh skirting a broad. The marsh is strictly preserved, and on it, as lately as last summer, bearded tits were plentiful. We had come in the full expectation of seeing both birds and nests, and were, if anything, rather encouraged than otherwise when the keeper — in the pessimistic tone common to men of his order when conscious that there is an unusually good head of game in front of the guns — told us that, though there was a nice lot of reeds uncut, he "doubted" we should not find any tits, as to the best of his belief there was not one of them left in the place.

But before an enjoyable day was over his words had acquired a different meaning. We tramped the marsh, which teemed with other bird life, backwards and forwards. Twice we flushed a mallard from a nest well filled with eggs. One nest, with a clutch of ten, was downed almost as thickly as an eider duck's, with a well-trampled path like a miniature sheep walk leading from it to the water's edge. From behind a stock of reed-sheafs we watched for ten minutes a pair of teal playing together — unobserved, as they supposed — in a rushy pond close by. Shovellers, with fantastic coloring and great flat beaks out of all proportion to the size of the bird, rose more than once within a few yards of us, and after circling once or twice, pitched again not far off. Tired-looking swallows sat disconsolately in parties of five or six on bushes, or rose to skim over the water in a half-hearted way, and light again.

A pair of redshanks crossed us once or twice, flying in line, one just behind the other, whistling loudly as they flew. Cuckoos called, and overhead snipe poised themselves, drumming and bleating and dropped like stones as they neared the ground. In the nest of one of them we say a beautiful instance of "protective coloring," the marvel of which never loses its freshness. The keeper the day before our visit, had found the nest, and for our benefit had marked the spot. It was in a line between two bushes, within half a dozen yards of one which stood alone and unmistakable on flat ground, with nothing on it bigger than a few short sprits which could hide the nest. As we neared the spot, the bird, to show there could be no mistake in the mark, rose close by us. For more than a quarter of an hour we looked, — three pairs of eyes, one pair the keeper's,—crossing and recrossing every foot of the ground, and were giving up the search as hopeless, thinking that a crow perhaps had hunted the marsh in the early morning before us, when in the middle of a tussock of sprits at our feet we saw a maltese cross of very green eggs, mottled irregularly with brownish-red, exactly imitating the bed of green moss from which the sprits grew. The color of snipes' and many other eggs is very volatile, and no one who has only seen them "blown" in a cabinet can quite realize their beauty when seen in the nest, fresh-laid and untouched.

At intervals of our tramp on shore we took the boat, rowing across corners of the broad, or pushing our way through ditches or narrow twisting channels. We saw coots' nests in plenty, and one unfinished nest of the great crested grebe, — the one rare bird which has made some return for the trouble taken of late years for its preservation by becoming more common. A floating mass of weeds, fished up, wringing wet, from the top of the water, looks a hopeless nest for a bird to hatch her eggs in; but, like a damp hay-stack, it generates very considerable heat. "In a grebe's nest" writes Mr. Southwell in the third volume of "Stevenson's Birds of Norfolk," just published, "in which were three eggs and a newly hatched young one, the thermometer rose to 73°, showing that the nest, so far from being the cold and uncomfortable structure by some supposed, was a real hotbed. On inserting the thermometer into a beautifully neat and dry coot's nest, which the bird had just left, I found the temperature to be 61°. The day was wet and cheerless, and the maximum reading of the thermometer in the shade was 58°."

We saw through our glasses several crested grebes playing on the broad. Oddly enough, the common little grebe — the "dab-chick" — is less plentiful in Norfolk than it is in St. James's Park, where last year as many as six pairs, all wild birds, nested and brought off their broods.

For six or seven pleasant hours we hunted marsh and broad with eyes and ears open. But not once did we catch sight of a feather, nor once hear the silvery "ping" of the note, of the bearded tit.

It was, of course, one corner only of a wide district, over the whole of which the bird has been well known, that we had explored. There are other broads and marshes where local circumstances may have tempered the killing wind. There, while we looked for them in vain, busy parents may have been working hard from morning till night to cater for the wants of hungry families safely hidden in daily thickening growths of bog flowers and grasses, and another year the deserted reed-beds we visited may be repeopled.

But as we drove home the conviction forced itself more and more strongly upon us, that, from one at least of its most favored haunts, the bearded tit has disappeared, and that it is not improbable that very soon — perhaps before this year is over — naturalists may be telling the sad story of the extinction of one more English bird.

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.*

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Atmospheric and Seismic Influences.

IN your issue of May 1, I had the honor of reporting a coincidence in time between two peculiar phenomena, the first the collapse of the fire-area of Halemaumau in the crater of Kilauea on March 5, and the second an unprecedented fall of the mercury in Honolulu to 48° F., on March 4. I remarked that this was perhaps not a mere coincidence. I now have the satisfaction of reporting a third phenomenon occurring at the same time, which is undoubtedly connected with the second, and which may aid in finding a connection with the first.

By the return from the Caroline Islands of the missionary bark-entine "Morning Star," on the 19th of June, we get word of a severe hurricane on Strong's Island, or Kusaie, on the 3d, 4th, and 5th of March (or 2d 3d, and 4th here). This island is in about 5° north latitude, and 162° east longitude, or about 3 400 miles west of Honolulu. Most of the breadfruit and cocoanut trees were uprooted, and a majority of the houses destroyed. The force of the waves threw up an islet, half a mile long and five feet high, on the outer edge of the fringing reef. The severity of the blow was from the north east. No barometer was observed there. No gale was experienced at other islands, so far as heard from. There was a sudden fall of the barometer at Honolulu on the 2d of March (3d at Kusaie).

The atmospheric change here is readily connected with the disturbance at Kusaie. To show a connection of the latter with a disturbance of the earth's crust on Hawaii is not quite so easy, although I believe that coincidences between hurricanes and earthquakes are common. What happened on Hawaii was a subterranean fracture in the lava duct of Kilauea, which let its contents escape and apparently become distributed under the Kau desert to the south-west, where lively earthquakes occurred. I suggest that a common cause of the atmospheric and the seizmic disturbances is to be sought for in astronomical conjunctions, possibly connected with sun-spots. Account should probably be taken of the severe blizzard of March 10, in England. SERENO E. BISHOP.

Honolulu, June 30.

The Collections of the Late Professor Parker, F.R.S.

IN a letter recently received by the undersigned from Professor W. Newton Parker, F.Z S., of the University College of Cardiff, Wales, a son of the late eminent Wm. Kitchen Parker, the vertebrate morphologist, I am informed by its writer that "My father's executors have decided to sell the greater part of his collection, which includes numerous skeletons (mainly of birds) and a large number of slides of *Foraminifera*, etc. Do you think that any of the public institutions in America would be likely to want any of these? . . . I hope you will forgive my troubling you about this matter, and I only venture to do so knowing you to have been a friend of my father's, who has an interest in him and his work."

The late Professor Parker's labors in comparative morphology for almost the last half century are so very widely known to science the world over that it is quite unnecessary for me to dwell upon them in the present connection. Their results, as published in the proceedings and transactions of the various learned societies of Europe since 1857, have long become in the highest degree classical, and they are as standard as they are imperishable.

Pressed by the necessity to obtain the requisite animal forms wherewith to illustrate his many and voluminous works, Professor Parker became a patient and indefatigable collector of morphological material, and at the time of his death his private cabinets stood among the largest and best in existence. As will be seen from what his distinguished son says, that collection is soon to be placed upon the open market for disposal. From my own personal knowledge, gained through a correspondence with its collector extending over a number of years, I can state that it simply represents a perfect mine of anatomical wealth, abounding in alcoholics of the rarest of vertebrate forms, in carefully worked out skeletons of all the classes of the animal kingdom possessed of a bony skeleton, in unique types, and in a rich mass of illustrative material for the *Invertebrata*. Fortunate indeed will that institution be that can secure by purchase this great treasure, and I feel sure that American science is with me in the devout hope that it may as a whole be obtained by this country. More than a generation will surely pass by before such another opportunity will be offered our museums to so enrich their collections in departments of such paramount importance, — and yet it needs but a word from some one among the wealthy, or the timely action of our own government, to have all this conveyed to our shores. Think for an instant how the inpouring of that material would swell and fill the gaps in the collections of the United States National Museum. What a living repository of reference would be there for the students in science for ages to come. Let it be hoped that the bare suggestion of the above facts is sufficient for our prompt action to secure for ourselves such a rare treasure as Professor Parker's collection.

Dr. R. W. Shufeldt.

Takoma, D.C., July 7.

AMONG THE PUBLISHERS.

The Forest and Stream Publishing Co. announce a new and enlarged edition of "Steam Yachts and Launches; Their Machinery and Management," by C. P. Kunhardt. The work has been extended by the addition of several chapters and many new plates, to keep pace with the growth of steam yachting.

— The Cassel Publishing Company will issue immediately, by arrangement with the English publishers, Miss Menie Muriel Dowie's book, "A Girl in the Karpathians," in which she gives an account of her travels among the mountains of Russia-Poland. The book is illustrated with maps and bits of scenery, and contains a full length portrait of Miss Dowie in flannel shirt jacket, knickerbockers and Tam-o'-Shanter, as she travelled on horseback and alone through this wild region. Miss Dowie, who is in her early twenties, is the young lady who aroused the enthusiasm of the British Association by an address before that learned body on her return from her travels.

— E. & F. N. Spon, Publishers, 12 Cortlandt Street, New York, announces as ready, "Telephones: their Construction and Fitting," a practical treatise on the fitting-up and maintenance of telephones and the auxiliary apparatus, by F. C. Allsop; and "Practical work in Organic Chemistry," by Fredk. Wm. Streatfeild, with a prefactory notice by Professor R. Meldola.

— An ephemeris for the use of members of the astronomical department of the Brooklyn Institute, July to December, 1891, prepared by the executive committee of the department, has just been issued by the Institute. Garrett P. Serviss, president of the department, says that the purpose of the ephemeris is to present in a convenient and readily accessible form information about variable stars, meteors, occultations, and other phenomena, with the hope that many may be induced to undertake observations which will certainly prove to be interesting to the observers, and cannot fail to be valuable to the department by giving a definite direction to the efforts of its members. The greatest charm of the starry heavens is felt only by those who study them systematically, but for that purpose an observatory, and even a telescope, is not essential. With an opera-glass, and with the naked eye, many of the most interesting phenomena of the sky may be satisfactorily and usefully observed. Arrangements have been made to furnish special information and assistance to observers at the meetings of the department, which will be resumed in October, and in the meantime members are requested to observe, in any way that may suit their convenience, the phenomena to which attention is called in the ephemeris, and to make notes of their observations. The president of the department will be particularly obliged if members will, at their earliest convenience, inform him, by letter or otherwise, of their intention to undertake any of the observations recommended. Any request for additional information or advice will meet with prompt attention. It is intended to make the department of astronomy one of the foremost in the Brooklyn Institute, both in the attractiveness of its meetings and in its general influence, and every member who undertakes any of these observations will give material assistance to that end.

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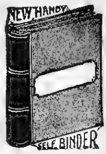

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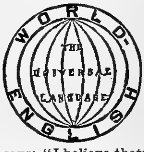

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SCIENCE

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MUSEUMS AND THEIR PURPOSES.[1]

I HAVE to thank the secretary and curator of this academy for the opportunity to state publicly some thoughts which have been uppermost frequently in my mind during several years past, but which I have never had occasion to put into form. In the North-west, educational methods and institutions are yet in their formative stages. This is still more the case with scientific education and scientific institutions. But we are fast laying foundations for posterity to build upon, which we ought to plan with a far-reaching vision into the future. Our mistakes, if we make them, will be forever laid at our door; and our children and our children's children will condemn or approve of us and our labor in accordance with the degree of fitness that they find between the foundations that we lay and the superstructure which they may have to build thereon.

It is because I think I can see in the future of scientific work in Minnesota some glimpses of the outlines of that superstructure, that I wish to call your attention to some of the fundamental essentials that ought to enter into the foundation which we are called upon to lay. Minnesota is an empire, territorially of itself, and it will become the "empire state" of the North-west, politically, educationally, and financially, and it ought to become the leader in the North-west in scientific enterprise and organization. In this organization of scientific work in the State, the museums will play no inconspicuous part. It will be safe to say that at those centres where the museums are located will be found in greatest efficiency all the other scientific agencies, whether of laboratories, libraries, or lectureships. There is a fitness in their association, almost an invincible bond of attraction, which will ultimately overthrow all the accidental or artificial devices which, in our possible short-sightedness, we may throw about them to keep them asunder.

A museum was originally a temple in which the muses were worshipped or invoked. At Athens, a hill near the Acropolis was called the Museum because of the existence on it of such a temple. It was a place for study and high contemplation. Although we have outgrown the mythology of the Greeks, their literature and their institutions have so pervaded our language and institutions that we find the germs of some of our choicest civil and social growths sunk deep into that old civilization. Those germs have fruited, in part, in our day, and the fruit is somewhat different from what the germs seemed to foreshadow. The germ of the museum at Athens, fraught then with prophecy of poetry, art, and history, had but little promise of science. The muse of astronomy was but one of the nine whose shrines were in those temples. Scholars who sought the museum were inspired with visions of the beautiful and the poetic, or of the light and passionate frivolities of life. There was no muse of geology known, though that science, by her aid, was to be a potent factor in preserving and perpetuating the words "muse" and "museum" in the new civilization; nor any muse of biology, though the poetry of biologic science has since been a prolific branch of modern scientific literature. There was no muse of botany, nor of paleontology, nor of electricity. I think that if the Grecian Museum had continued to the present, the number of the inspiring muses would have been increased far beyond the mythical nine. That dynasty has passed away, and with it has almost been lost the original idea of the museum.

The word, however, which is imperishably stamped on the language of all modern civilized nations, remains. It bears a weird, and to the original nine who gave it origin and character and authenticity, almost an unknown signification. Let us look into this a moment, and endeavor to learn what is the modern meaning of this word "museum." We shall find that it bears three interpretations, or dominant ideas. First, there are museums designed for entertainment; second, there are museums intended for the instruction of the visitor; third, there are museums for research.

The modern so-called "dime museum" typifies the museum designed for entertainment, although in many such may be found some of the characteristics of the second class. It is a place of "curos'ties" and monstrosities, of cheap theatricals and legerdemain. Such have long been known, although under different names, in the principal cities of Europe and America, the most noted in this country being Barnum's Museum in New York City thirty-five or forty years ago. Here the visitor is wholly passive under the manipulation of the presiding genius of the place. He may enter the presence with any foreign, or even adverse sentiment. He simply is willing to be amused for half an hour.

The modern museum designed for instruction has a somewhat higher function and rank. Its purpose is to inspire in the visitor a thirst for knowledge, and in a degree to furnish that knowledge, at second hand. He seeks not that amusement may be lavished upon him, but he is at least willing to put forth an effort to obtain information. With this end attained he is satisfied. The instruction he has received remains in his mind unclassified and generally unassimilable. He knows more of the earth and of the things upon it when he retires from the place than when he approached it. Of his mental capacities his memory only is necessary thereafter to enable him to make useful that which he has seen. He is instructed and benefitted in so far as he appreciates and retains the ideas which the various objects have brought to his mind. Such museums are common. They accompany nearly all modern institutions of higher learning. They are patronized in proportion to the number of instructive objects they have on exhibition, or the variety and beauty of their specimens, or of the cases in which they may be contained. They serve, like travelling circuses, to attract the light-minded and the curious; but their service is higher than that of the circus, in the higher grade of information which they impart, and in the greater benevolence of the motive for which they are maintained. Such museums discharge an important function in education, and particularly in scientific education, and to this day they express the popular idea of a perfect museum. They may sometimes partake of the elements that characterize the third class, or the museum for research, and, in so far as they do, their sphere is raised nearer the true ideal. In general, however, they are far removed from the true museum, and from the germinal idea which was planted in the Grecian mind. You will note that the motive of the patron in both these cases is one of self-improvement or gratification. He has no object ulterior to that of being himself benefitted. There is, moreover, in the museum itself, no other purpose expressed, nor any possibility of any other purpose being accomplished by the visitor.

These appendages to the science departments of our colleges are considered desirable and even necessary. In the curriculum, however, for making scholars, and for rendering students capable in their turn of teaching other students, or in making well-informed, self-reliant scientists, they serve but as subordinate agencies. They do not answer to the ends of scientific instruction in that degree that is demanded by the scientific advancement of our day, nor in that degree with which the ways and means of classical instruction at this day answer to the classical learning of our day. The classical student, even when he begins the classics, is brought into immediate and personal contact with the thing which he studies. The problems presented to him,

[1] A lecture delivered before the Academy of Sciences of St. Paul, Minn., by Professor N. H. Winchell, State geologist.

require him to investigate the principles of the language for himself to the best of his ability, and the preceptor comes to his aid only when his translation is so faulty as to require correction. He is constantly at his wits' ends to discover the ideas hidden in the text before him. In those institutions, however, which are endowed with these exhibition museums, the scientific instruction is not usually a requirement to study the subjects by original investigation, but a requirement to read, listen, absorb, recite. It is an instruction on a parallel with early childhood. It is an inpouring process of imparting information. It is not by any means on a par with that instruction which everywhere is given the classical student. One imparts enlightenment, and the other mental strength and culture. There is justice in the claim set up for the study of the classics in such cases, viz., that they furnish a better mental training and culture. How much of this claim, which is common only among those who have never had a scientific training in the scientific method, is due to the prevalence of this kind of scientific teaching in our colleges, would be an interesting and fruitful inquiry, if thoroughly investigated.

Suppose, on the other hand, that scientific instruction were as thoroughly organized in all the colleges of the country as is that of Greek and Latin. Suppose on the analytic, or on the inductive method, all scientific truth were imparted to the student. This would, of course, be impossible in the ordinary undergraduate course without disturbing the present *status*, in which only mathematics and the classics are thus taught. Suppose the student were shown a list of scientific problems which he must solve, with only the guidance of his native resources, and a few hints from his instructor as to the principles involved. Then let another series be presented, which, while involving those already answered, should demand still further and wider investigation. Suppose a whole term be spent in that way; nay, let us suppose a whole year, yes, three or four years, and, in order to make a parallel case, let us require that before presenting himself for admission to the freshman class the student shall have spent a year or two in similar independent investigation within the preparatory school. Then let it be further supposed that this method of scientific instruction were well established, with competent instructors in all the colleges of the country, with a public sentiment sufficiently informed to sustain it, and that it had courses of study well organized and differentiated, leading to honorable degrees at graduation, and public emoluments inviting to its pursuit, — then, and only then, could the disciplinary value of scientific education be compared fairly with that of the classics.

You may see at once that an exhibition-museum, as an attachment to an institution dominated by the old ideas of education, is only expressive of the kind of scientific education which such an institution desires to impart. It is only the sign of the enslavement of the scientific idea, in all its educational machinery, by the classical. To my mind, the establishment of such a museum would not be the best way to introduce scientific instruction into any college, however successful it might be in touching the popular appreciation or in opening the popular purse. The best scientific instruction is based on other foundations, and pursues other methods, and reaches other ends.

The true museum is that which approaches nearest to the cardinal idea of the Grecian museum. Its aim is not to amuse, nor to instruct, but to afford that inspiration which shall enable the visitor to instruct others. The reverent devotee approaches such a museum with no selfish motive. He invokes his muse to inspire in him sentiments that shall benefit his fellow-men. When I say that there are but few such museums in our day, you will not question the statement. You will rather inquire whether there are any such in existence. Such a museum is based on a broader idea than the exhibition-museum, although its frequenters may be fewer. Scientific research, long-continued study, profound contemplation, and conference with the writings of others — these are the purposes of such a museum. In but few places is this carried out, but it is the fundamental and growing idea underlying some modern museums. The full fruition of this idea will be the culminating result of the germ which was planted in the early Grecian soil. Transferred to modern times, ripening in the sunlight of a new civilization, with its roots nourished by more genial influences, the germ of the Grecian museum produces in our day, or is beginning to produce, a fruit somewhat different, although generically it is identical with that which it bore under Athenian culture.

Modern society is beginning to awaken to the debt that it owes to modern science. Modern science is the savior and promoter of modern institutions, the generator and sustainer of modern civilization. I speak not of the influence of the Christian church in modern times, because the Christian church cannot be accredited with the revival of modern science, nor with the inauguration of modern civilization. The Christian church existed through the darkest epochs of the middle ages, and gave no aid to science. Modern science, which, in its ramifications into social affairs, is the distinguishing badge of modern civilization, rose in spite of the church, and against its active opposition. This is not the fault of Christianity but the fault of those who were responsible for misrepresenting Christianity. The germinal motive of the Grecian museum — the search after truth and the desire to be inspired by it — was also the germinal idea of Christianity. Its fruition is the effort to serve and to save others. Many generations passed during which the germ slumbered, or was smothered under the tares of human ambition and sophistry. At length it pierced through the adversities by which it was surrounded, and began to manifest itself by its good works, and by the good which it reflected upon its enemies. The church was the nominal custodian of the germ, and ought to have welcomed and enjoyed its first fruits; but it did not. The sturdy growth which it now presents to modern society has reacted upon the church, and the church begins to recognize what a nearly fatal mistake she made in trying to smother the young plant. She now perceives that the plant is very similar to her own, and that the fruits of the two are nearly identical. Whereas she had discarded it, at its first appearance, as a vicious and foreign weed, she now is willing that it shall be transplanted into her own field and shall be nurtured by the same hands.

It is only with this recent awakening of modern society to the usefulness and beneficence of modern science that the true idea of a true museum has become again apparent. This idea finds illustration in a few museums in all the great nations of Europe and America. The highest enlightenment is compatible with the highest efficiency of these organizations, for they are the great dynamos that keep the machinery of modern advancement continually moving. This, however, has been the result of a growth whose former stages were insignificant, and perhaps but faintly foreshadowed the form that the completed museum should take on. This growth had a natural philosophical as well as chronologic order. We might appeal to history to show this. From the lowest form of a museum meant for amusement simply, consisting of a collection of rare and grotesque objects, rose that which embraced the idea and purpose of education. With instruction, still variously larded with amusement, gradually came necessarily the last term of the series, viz., an eagerness for research. This last term, first put into ideal form by Lord Bacon in his "New Atlantis," near the end of the seventeenth century, in which he works the idea of a great national museum into his romance, was definitely recognized and enacted by parliament, in the establishment of the British Museum in 1753. The Louvre at Paris, containing the great national museum, was converted from a royal residence and playhouse when in 1789 it came into the possession of a republican government.

But I need scarcely mention, to this audience, those museums which exemplify the idea which I am trying to inculcate. If you call to mind those bee-hives of industry where are stored the choicest collections of years, or of centuries, representing all departments of knowledge, whether of natural science, or of history and antiquity, or of literature, or of art, in which the nations of the earth take the greatest pride, you see, perhaps, in Britain, the great British Museum, with its numerous departments and its libraries, or the United States National Museum at Washington, or some of the great continental museums. These great collections subserve the ends both of instruction and of research, but chiefly their purpose is to aid the student in research, although this was not the prime object in their establishment. As already stated, however, when the second phase of museum-growth has been attained, viz., the idea of instruction, the last term of the series necessarily follows, and the museum takes on the last phase of its development — it becomes a place for research. It is by no means necessary that this last stage should exclude the functions of education and enlightenment. It is better that they co-exist. They aid each other. The instructed visitor may become an investigator, and the greater the number of enlightened visitors leaving its rooms, the greater the number of truth-seekers will be who frequent its laboratories and libraries.

As a museum takes on this highest function, however, it retires more and more from public gaze. Its cases and its drawers may be well filled with well-arranged and labelled specimens, and the casual visitor may imagine he has sufficiently seen the museum when he has passed through its public halls. But he has not seen the working of the museum in its highest departments. In the numerous laboratories are more specimens than those that are on exhibition. These are for the eye only of the true seeker after truth. The student-patron enters all the recesses, and has access to all the specimens. He alone invokes the muse in the spirit of the early Greek poet. Unobtrusively he solves his great problems. Unselfishly he proclaims the new truths to the world. His service is as sincere, and as necessary to the development of modern civilization, and to the apprehension of the laws of nature, whether they be the laws of gravitation or of brotherly kindness, as that of any truth-seeker or man-lover. The laboratories and recesses of these great museums, which are unseen by the public, are crowded with such devout truth-seekers.

We come now to consider in what manner this review can be made to apply to the people of Minnesota, and especially to the city of St. Paul.

On another occasion (Bulletin Minn Acad. Sci., Vol. I., p. 389) I have attempted to set forth the superior advantages and inducements which Minnesota possesses for the cultivation of modern science. They need not be repeated here. I will simply refer to them. The lapse of eleven years since that time has served to confirm my statements, and to emphasize the reasons enumerated then for maintaining in the State a prosperous and active academy of science. I am still convinced that there will arise, either in St. Paul or in Minneapolis, an efficient scientific organization; and that its work, when duly established, will be of great benefit to the State along the line which is above indicated. It makes but little difference whether it be in St. Paul or in Minneapolis, nor under what auspices, or whether in both cities by a union of effort; its effect will be upon the whole State, and upon the North-west, and it will be the quickening and guiding power for the advancement of all practical and theoretical science, drawing about itself the enterprising and educated artisans of all classes, as well as the patient and studious investigators.

Such an institution would be a museum in the highest sense. I will try to sketch some of the prime essentials of such an institution, after the money is available for its establishment and support. It will not be necessary, were it possible, to state what amount of money should be placed at the back of such an institution, but I will permit you to estimate that as I proceed, and also to devise possible ways and means for raising it. To found anything, money must be had. Presuming, however, that the means for such a museum were at hand, I will simply outline a plan, and the equipment which should characterize it. We will assume that the institution will include within its scope only the natural sciences, so-called, although all sciences are natural.

The ideal museum should have, first, suitable permanent quarters for its local habitation. These quarters should be adapted to the uses to which they are to be put, and should be planned and erected with constant reference to economy of labor and time for the workmen who are to occupy it. This is so obviously necessary that it seems, at first, that it need not be stated. Yet its neglect is a common mistake. How often are the planning and construction of such a building put into the hands of some professional architect, with instructions simply to erect a building of good architectural proportions and fine appearance. In the main such a building should contain rooms for laboratories, for storage, for exhibition, classification, and, perhaps, for lectures.

Second, the ideal museum should have materials, in the form of multifarious collections, and the ways and means for increasing them, and of exchanging them with other museums. While some of these will be put on exhibition, at least those which have been sufficiently examined and classified, the larger portion will be kept in storage for the use of its collaborators.

Third, such a museum will be well supplied with apparatus and libraries, and the apparatus will consist of the best makes and of the latest improvements. I wish to emphasize the libraries. There is nothing that the scientific student so much needs and which he is most frequently without, as a library of those works which pertain to his science. He wishes to know what others have discovered, or what they have failed to discover, what methods others have followed, and what paths are still untrod. It is one of the difficulties of most scientific institutions, especially of new ones, to procure means for the scientific literature pertaining to the sciences which they are supposed to cultivate.

Fourth, for the efficient working of such a museum, there must be a corps of scientific collaborators, sufficiently paid to relieve them from anxiety for their comfortable subsistence, and that of their families.

Fifth, means for publication, either by lectures or by printing. It would be better that both these methods of publication be pursued. The former disseminates information quickly and cheaply. The latter is more formal, and more permanent, furnishing means for recording facts and principles with carefulness and thoroughness, and with a view to future reference.

Sixth, such a museum should have its administration unified and harmonized by being under the responsible charge of one man. There should be a plan for its work, outlined by the proper authority, and that plan, with the rules which it should involve for the government of all the collaborators, should be enforced with persistence and fidelity.

Are we ready for such a museum in the State of Minnesota, or for such an institution under any other name? Are the citizens of St. Paul ready to undertake such an enterprise? Have we the elements which enter into such an organization at our command, or any part of them? Have we the live nucleus round which such an institution can be built up? Have we the men who will devote themselves to its establishment and support?

I have seen something which Ex-Governor McGill has said recently on this subject, and it is so apropos that I will repeat it here: "There should be somewhere in Minnesota a great polytechnic school which would impart instruction in mineralogy, mechanics, and the various arts and sciences usually taught in such institutions. This should be established on a large, comprehensive scale, making it a university in its scope. Such an institution would attract the attention of all the country, be a lasting benefit to the city of its home, and meet a pressing public demand for industrial and technical education. St. Paul is the place for such a school, provided always she has the intelligent enterprise to establish it." These are the words of one of our ex-governors, whose means for knowing the needs and the facilities for higher scientific education in the State may be supposed to be the best.

There are numerous museums, and schools of technology, and so-called mining schools in the United States, which in a measure subserve the purposes which I have set forth for an ideal museum. The American Museum of Natural History in New York, the Museum of Comparative Zoology at Cambridge, the New York State Museum at Albany, the Philadelphia Academy of Sciences at Philadelphia, the School of Technology at Boston, supplemented by the museums and libraries that are adjacent, these are based essentially on the central idea of a true museum, such as we ought to have in Minnesota. Similar plans underlie the scientific work at several of the larger universities, but in these institutions the fogs of mediæval prejudice are apt to dwarf the growth of scientific work, and to overburden the few and struggling preceptors with the elementary instruction which ought to be required of the student before he enters the freshman class.

If we take an inventory of the elements which we have toward such an institution in St. Paul, we shall find the following: First of all, the St. Paul Academy of Sciences, which is apparently willing to serve the public in the cause of scientific enlightenment.

This may be considered the germ, which, by its growth, may quicken with its spirit all the other elements. Second, the Minnesota Historical Society, whose plan of organization, however far it has lapsed from it, is so broad that it embraces the objects which we seek, and which would be a powerful factor in any re organization for scientific work in St. Paul. Its library, its collections, and its good will would go far toward causing the State legislatures to vote enlarged funds for its sustenance, should the ideal museum be made to include this society. Third, the Public Library of St. Paul should be mentioned as one of the elements at hand which should be brought within the pale of this ideal museum. There may be other libraries and organizations of which I am not cognizant, whose usefulness and whose expressed aims would be better subserved by a combination with others.

Add to these elements an enlightened and wealthy community, largely in sympathy with the advanced science of the day, and, I think, we have mentioned every thing on which we can depend. There are, however, other nearly allied institutions which might be willing to co-operate, and, on the plan of "university extension," join in whole or in part in a general movement. I refer to Macalester College and Hamline University. Should all these elements express a willingness to join in the creation of a great central scientific institution, for which I would retain the name of "Museum," they should all be housed in one building or series of buildings, and should be brought under one administration. Their efforts would then be brought into sympathetic and harmonious activity, and instead of smothered jealousy, one of the other, each one would have its function so defined that they would help rather than hinder each other, and the result would be a conservation of energy and money, which now are sometimes lost by being duplicated from different sources, or by being ill-advised and ill-directed.

I have sketched out what appears to me to be the museum of the future in Minnesota. I have indicated what should be its plan and its purpose. I have shown the necessity existing for such a scientific centre in this State, and I have lastly enumerated the elements that might be united in such an institution in St. Paul. The immediate steps that should be taken to bring about such an end, it will be necessary for you to decide upon should it be attempted. For nineteen years I have had the hope that such a museum might arise in Minnesota, and that in my day I might be in a measure instrumental in bringing it about. I would like to inspire some of the wealthy friends of science who reside in St. Paul with the faith which started some of the great museums of the world, or with the consecration which actuated Agassiz, or Smithson, or Rensselaer, or Franklin, in founding the institutions which bear their names.

NOTES AND NEWS.

The effect of adding aluminum to steel ingots was discussed at considerable length at the recent meeting of the American Institute of Mining Engineers, communications on the subject by Professor J. W. Langley of Pittsburgh and Professor J. O. Arnold of Sheffield being among the papers read. Professor Langley drew attention to the very small quantity of aluminum required to render steel castings perfectly sound. The aluminum, says *Engineering*, is added in small pieces of from a quarter to a half pound in weight, thrown into the ladle during the tapping after a small quantity of steel is already in it. The aluminum melts almost instantaneously, and diffuses with great rapidity throughout the contents of the ladle. For open-hearth steel, containing less than .05 per cent of carbon, five to ten ounces of aluminum are sufficient for each ton of steel, while for Bessemer steel the amount should be increased to from seven to sixteen ounces per ton. For steel containing more than .5 per cent of carbon the aluminum should be used cautiously in amounts of from four to eight ounces per ton. Professor Arnold described briefly the results of a number of experiments at the Sheffield Technical School, from which he concludes that the action of aluminum is about twenty times as powerful as that of silicon, and the resulting steel is tougher and sounder than when silicon is used, provided that certain precautions against piping are taken. He considers that the action of the aluminum is almost certainly chemical. The blow-holes in ingots are due to occluded gases, and it has been proved by experiment that aluminum readily reduces carbonic oxide at a temperature below that of melting steel. In one experiment Professor Arnold blew forty gallons of pure carbonic oxide through a crucible of molten steel containing aluminum, with the result that the carbon in the steel was increased by thirty-five per cent, owing to the reduction of the gas. He concludes that by using aluminum, manganese can be dispensed with, and a considerable saving of time and fuel effected.

— A new antiseptic, said to have certain advantages over those hitherto in use, has been brought before the French Academy of Medicine by Professor Berlioz of Grenoble. Extreme solubility, harmlessness, efficacy, and rapidity of action are claimed for it. It is called "microcidine," and, as described by *Nature*, is a compound of naphthol and soda, is neither poisonous nor irritant, is twenty times as active as boric acid, and much more soluble than thymol, carbolic acid, etc. Microcidine has the form of a grayish white powder. In a solution of three grams per litre it is very slightly colored, but it does not stain either the hands or bandages. For family use it is said to be of great service.

— An apparatus has been recently constructed by M. Ducretet, says *Nature*, for getting quickly in the laboratory a fall of temperature 70° to 80° C. below zero, by means of the expansion of liquid carbonic acid. The inner of two concentric vessels contains, in alcohol, a serpentine metal tube communicating, through a tube with two stopcocks, with the carbonic acid reservoir outside, and opening below into the annular space round the inner vessel, in which are some pieces of sponge impregnated with alcohol. This two-walled vessel with coil is inclosed in a box. One stopcock being opened wide, the other slightly, the carbonic acid passes through the coil as snow, and turns to gas, with strong cooling effect, and any of it not vaporized in the coil is dissolved in the alcohol of the sponge. The gas escapes through a tube passing through the outer box. The instrument, called a *cryogen*, is pictured in *Cosmos* of June 27.

— Experiments have lately been made by Herr Regel (*Bot. Centralb.*) with reference to the influence of external factors on the smell of plants. In the front rank, as stated in *Nature*, appears the direct and indirect influence of light on the formation of etheric oils and their evaporation. In the case of strongly fragrant flowers (as *Reseda*), heat and light intensify the fragrance, which in darkness is lessened without quite disappearing. When the whole plant was darkened, those buds only which were before pretty well developed yielded fragrant flowers; the others were scentless. If, however, only the flowers were darkened, all were fragrant. Other plants open their flowers and smell only by night (as *Nicotiana longiflora* and *Nycterinia copensis*). When these plants were kept continuously in the dark, they, in course of time, lost their scent, as they lost their starch. On being brought into light again, both starch and fragrance returned. Besides light, respiration has a decided influence on the fragrance. Nycterinia, inclosed in a bell jar with oxygen, behaved normally, but with hydrogen the flowers did not open, and had no fragrance. In general, the opening of flowers coincides with their fragrance, but there is no necessary connection between these phenomena.

— Dr. Anderson, in a recent paper on steel read before the Iron Institute, London, explains the peculiar action of the solid iron when thrown into molten metal. When thrown into a pot of molten iron or steel the solid metal at first sinks, which shows that its volume per unit of weight is less than the heated metal. But soon the solid piece becomes heated, which causes it to expand, its volume is increased, and it rises and floats on the surface of the molten mass. The action is the same with both iron and steel. The experiment was frequently made by throwing a piece of iron into melted steel. It could be seen to go down, and one might think it was on account of the impetus which the iron had attained in falling that height, but as a matter of fact if the iron were put upon a fork and lowered, it would go down. In the course of a few seconds it came up again, and kept on expanding until the piece of iron was a considerable distance above the surface of the metal. Then it decreased in volume, and of course became of the same volume as the molten metal which it joined. Any one could see by the distance that the piece of iron went above the surface that it was of considerably less density than the molten metal.

— The German East Africa Company, according to press reports, has decided to spend $15,000,000 in building a railroad from Tanga to Karagwe. Tanga is a little seaport about fifty miles north-west of Zanzibar, and Karagwe is distant from the starting point about 625 miles. It is the country of the good old King Rumanika, who so charmed both Speke and Stanley that they credited him with most of the virtues, and pictured his country as an African paradise. The proposed railroad, by starting from Tanga. will avoid the hard climb up the Usagara Mountains. It will doubtless run almost due west to Tabora, the centre of things in inner East Africa, and will then strike north and north-west to Victoria Nyanza and Karagwe, which is within a hundred miles of the western boundary of Germany's possessions.

— The manuscript of the annual report of the Ohio experiment station was placed in the hands of the State printers in January, but the press of other work has crowded it back, so that it is only now being printed. The report contains a summary of the year's experiments, the full reports of which have been published in bulletins issued during the year. Among the subjects under investigation have been: potatoes, including trials of varieties, use of fertilizers, size of seed; commercial fertilizers, including trials on corn, wheat, and oats at the station and on farms in various sections of the State; experiments with corn, oats, and wheat, including tests of varieties, quality of seed, date of planting, and methods of culture; experiments in the control of insects affecting fruits, vegetables, and field crops; experiments in the control of fungus diseases of plants, as smuts, rusts, mildews, fruit rots, etc.; experiments with many varieties of fruits and vegetables, and investigations in some of the diseases of animals. The publications of the station for the year are, its regular bulletin, of about 260 pages; the annual report, some 60 pages; and a technical bulletin, of 100 pages, intended primarily for the use of other scientific workers. All are illustrated, and all are distributed free of cost to all persons in Ohio who are interested in agriculture or horticulture. Applications should be addressed to Experiment Station, Columbus, O.

— In the journal of the Elisha Mitchell Society, Mr. Atkinson calls attention to two new cases of protective mimicry in spiders. A *Cyrtarachne* takes shelter in summer and autumn under leaves, where it has absolutely the aspect of a small univalve mollusc, which is extremely abundant, and which often fixes itself in an analogous position. The second example is found in a small spider, *Thomisus aleatorius*, which is remarkable for the length of its fore-legs, the hind ones being, on the contrary, very short. This spider, which lives upon grasses, ascends the culm, stops suddenly, and disappears from sight. It suffices to fasten itself to a spike by its hind-legs, and to bring together its fore-legs, extended, and form an angle with the culm in such a way as to make itself nearly undistinguishable from the spikelets.

— Ultramarine has long been a chemical puzzle, alike in its constitution, the cause of its color, and the vicissitudes of its manufacture, but now, says *Industries*, there is reason to suppose that one of these questions is in a fair way to be definitely solved. Some time ago it was suggested that the color of ultramarine was due to the presence of an allotropic modification of the element sulphur, a substance capable of many vagaries. Mr. F. Krapp has recently pursued the former line of inquiry by investigating the so-called "black sulphur" of Magnus, which he finds to be not sulphur only, but a mixture of a certain modification of sulphur with a compound containing both sulphur and carbon. This modified form of sulphur by mere subdivision gives a blue color to the substance used to subdivide it, and there appears to be little doubt that ultramarine simply consists of a basis of colorless silicates impregnated with blue sulphur, resulting from the sodium sulphide formed in the ordinary course of manufacture. As blue sulphur in a state of isolation is unstable, and quickly passes into the yellow variety, it is easy to understand that on decomposing the colorless base by means of an acid, the sulphur itself undergoes change, and ultramarine as a pigment ceases to exist. Mr. Krapp suggests that this same modified form of sulphur may play a part in the production of vulcanite, and that the blue color of certain blast-furnace slags may be due to it. In any case, sulphur which boils at a temperature far above 440 C., whose vapor is colorless, which oxidizes to sulphur dioxide without visible combustion, and which itself is moreover blue, is a body sufficiently remarkable to warrant further research.

— It is more than probable, says *Iron*, that the Egyptains were in the habit of transporting vessels overland across the Isthmus of Suez, and tradition records that twenty-three centuries ago a true ship-railway, with polished granite blocks as rails, existed and was worked across the Isthmus of Corinth, where the construction of a ship-canal has been projected. In 1718 the well-known Count Emanuel Swedenborg constructed a road and "machines" for carrying laden vessels from Stromstadt to Iddefjord, in Sweden, a distance of fourteen miles across a rough country, and the successful use of this work by Charles XII. during the siege of Frederikshall led to Swedenborg being regarded not only as a national benefactor, but as a mechanician of no mean ability, for at least a century after his death.

— The census of British India was taken on Feb. 26 by nearly a million enumerators. According to the London *Times*, the population was found to be nearly 286,000,000, of whom 220,500,000 live in British territory, and 65,500,000 under feudatory governments. The increase during the past decade has been 26,000,000, or 29,000,000 if newly acquired districts be included. The density of population is 474 to a square mile in Bengal, 442 in the North-western Provinces, and 248 in Madras. In Sind the growth of population has been very marked. Burmah has also made rapid progress, owing to the abundance of land ready for new settlers, and Lower Burmah is now as densely peopled as Portugal. As regards the towns, Calcutta now stands first and Bombay second, but changes in town areas and errors in the preliminary report render it impossible to give an accurate comparison of urban populations at present.

— An interesting report, by Mr. Campbell, of the British Consular Service in China, has been issued by the British Foreign Office. According to *Nature*, it is the record of a journey of over 1,300 miles in districts in northern Corea, many of which have never before been visited by Europeans. Mr. Campbell started from Seoul, the capital, and crossed the peninsula to the treaty port of Won-san (Gensan), and thence pursued his way along the east coast around Broughton Bay, whence he turned north-eastward, crossing the Yalu River to Păik-tu-San, known to Europeans as the Long White Mountain, and already visited by Messrs. James, Fulford, and Younghusband. The return journey was partly over the same ground, but on arriving at Won-san Mr. Campbell recrossed the peninsula, and so made his way to Seoul. Besides the ordinary record of this journey Mr. Campbell gives a great amount of information on various subjects connected with Corea. The chief amongst these is a most interesting section on the prevalence of Buddhism in the peninsula, and one on the agriculture and productions. He gives a good deal of information in regard to the geography of northern Corea, and also of the gold production of the country. That Corea contains gold-bearing strata has long been known through the export of gold-dust from the ports, but from Mr. Campbell's report it appears that gold-fields do exist in considerable numbers, and that some of them are worked with the imperfect native methods. There seems no doubt that, if circumstances were favorable to the proper scientific working of the Corean gold-fields, the country would be one of the principal producers of the precious metal in the world. Education in the country seems to be at a very low ebb, and is confined to a knowledge of Chinese. All energy and enterprise is crushed out by an all-pervading tyrannical officialism, and poverty and squalor are universal.

— O. C. Charlton, late of Ottawa, Kan., has been appointed professor of natural sciences in the Texas Normal College at Denton.

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INVESTIGATIONS UPON NITRIFICATION AND THE NITRIFYING ORGANISM.[1]

THE nitrogen of organic substances is, for the most part, liberated during decay in the form of ammonia or ammoniacal compounds; and these substances yield, by oxidation, nitrous acid and finally nitric acid, which, in turn, in the form of nitrates, feeds the living plant, and thus begins again the cycle of transformation.

The oxidation of the nitrogen of ammonia, and its ultimate conversion into nitric acid, is called nitrification. This change is especially active in soils near the surface, where nitrates are formed abundantly from percolating waters which contain much nitrogenous matter.

This phase of nitrification, the formation of nitrates in porous soil, has been attentively studied: but less attention has been given to the process of nitrification as it goes on in surface waters, such as streams and ponds; and it is to this side of the question, namely, nitrification as it occurs in natural waters, that our study has been chiefly directed.

Some eighty samples of water, selected from the two hundred and forty coming each month to the laboratory of the State Board of Health, were examined at intervals of from two to seven days for ammonia, nitrites, and nitrates. These samples were received from all parts of the State, and included all classes of surface water, rivers, ponds, and reservoirs. They were examined repeatedly during the months of June, July, and August, 1888.

The results may be briefly stated as follows. The organic matter in suspension decays in about seven days, as is shown by the increase in "free ammonia." In about fourteen days this "free ammonia" has disappeared, and nitrite has taken its place, reaching a maximum in about twenty-one days. Later the nitrite too disappears, and in twenty-eight days or more all the nitrogen has been converted into the form of nitrate. When the suspended matter is removed by filtration through paper, or by precipitation with alumina, no change occurs unless free ammonia were present at the outset.

These changes were so universal, and so independent of the character of the water and of its condition of aeration, that it seemed important to avail ourselves of the unusual opportunity offered by the close proximity of the chemical and biological laboratories of the State Board of Health, to carry on a series of chemical and bacteriological investigations on solutions of known composition. Accordingly, we began a series of experiments covering a period of nearly two years, in which the daily and weekly changes caused by the growth of bacteria were watched from both the chemical and the bacteriological standpoint, in order to determine the sequence and rate of such changes. Other points came up in the course of the work, as will appear from the following pages.

It has long been known that the first step — the decomposition of nitrogenous matter, and consequent production of ammonia — is due to the vital activity of bacteria. The early experiments of Schwann and Schultze (1839), and the later and thoroughly conclusive work of Pasteur, showed that putrefaction of organic matter is brought about solely by the small vegetable organisms known as bacteria. Even after this fact became generally known, it was some time before the importance of the complete range of this discovery was suspected. It was still maintained that the process of nitrification proper — the oxidation of ammonia to nitric acid — was of a purely chemical nature, although the burden of proof was soon thrown on those who upheld this view. The close dependence of nitrification upon a rather narrow range of temperature, the cessation of the process on the addition of antiseptics, the operation of "seeding" one solution with another, the impossibility of effecting rapid nitrification by chemicals, the analogous phenomena of putrefaction, — all pointed clearly to the fact that nitrification depends on the presence of living organisms.

The first conclusive proof that such was the case, however, came from the work of Schlœsing and Muntz in 1877 (Comptes Rendus, 1877, Tome 84, p. 301). The work of these observers rendered it practically certain that living organisms of some kind are the true agents of nitrification. "It now remains for us," they said, "to discover and isolate the nitrifying organisms." Schlœsing and Muntz, in their subsequent investigations, believed that they had succeeded in making this discovery; but, in view of the facts of modern bacteriology, we are unfortunately unable to assign much value to this part of their work. It is not easy to satisfy one's self that Schlœsing and Muntz ever worked with really "pure cultures" of isolated species. While the work of these investigators established beyond all question the fact that nitrification, like the analogous phenomena of fermentation and putrefaction, is caused by living organisms, it left entirely open the precise nature of these organisms.

The first experiments with species of bacteria isolated by modern methods, and therefore undoubtedly pure cultivations, are those recorded by Heræus (Zeitschr. für Hygiene, I., 1886, p. 193). Heræus experimented with fourteen well-known species of bacteria, and with about as many others freshly isolated by himself from water and soil. He cultivated these in an ammoniacal solution, and obtained in the case of several familiar species good qualitative tests for nitrous acid. Among these species were *Bacillus prodigiosus*,

[1] Edwin O. Jordan and Ellen H. Richards, in report on water supply and sewerage to the State Board of Health of Massachusetts. (The series of experiments detailed in this paper were planned and carried out jointly by the authors, the bacteriological portion of the work being done by Mr. Jordan, and the chemical portion by Mrs. Richards.)

the Finkler-Prior bacillus, the bacillus of typhoid-fever, the anthrax bacillus, and others. Heræus concludes that all these organisms possess oxidizing powers, since they are thus apparently able to oxidize ammonia to nitrous acid.

The work of Adametz (Untersuchungen über die niederen Pilze der Ackerkrume. Inaug. Diss., Leipzig, 1886) and Frank (Forschungen auf dem Gebiete der Agriculturphysik. X, 56), on the other hand, did much to offset this positive result reached by Heræus. They found, as other investigators had found before them, that the introduction of a small quantity of garden soil into an ammoniacal solution would produce rapid nitrification. The various species of bacteria, however, which they isolated from this same soil, and introduced as pure cultures into sterilized ammoniacal solutions, refused to nitrify. In no case was more than a trace of nitric acid observed. Frank was so influenced by his continued negative results that at a later date he went so far as to deny that living organisms had anything whatever to do with nitrification. This sceptical attitude seemed for a time to be fully justified by the experiments of Celli and Zucco. It was soon, however, demonstrated by several skilful investigators that nitrification could not be accounted for by purely chemical influences. There was, nevertheless, no cessation in the publication of negative results. The work of Heræus was extended and elaborated by P. F. Frankland and by Warington. Frankland (Jour. Chem. Soc., April, 1888, Vol. LIII., No. CCCV., p. 373) failed entirely to obtain any evidence of oxidation of nitrogen by individual species of bacteria, and on this point came into direct conflict with Heræus. To use his own words: —

"The [ammoniacal] solutions were examined after forty days' growth, but in no case was anything more than a faint indication of nitrous acid obtainable with sulphanilic acid, phenol, and ammonia.

"It is worthy of notice that Heræus had experimented with three of the micro-organisms which we have had under observation, viz., *B. subtilis*, *B. prodigiosus*, and *B. ramosus*. On growing these in sterilized urine, he found that *B. subtilis* alone gave no nitrous acid reaction, whilst the other two gave distinct reactions for nitrites; from this he concludes that *B. prodigiosus* and *B. ramosus* possess oxidizing powers, and that *B. subtilis* does not. My experiments, however, conclusively prove that both *B. ramosus* and *B. prodigiosus* exert a reducing action, whilst *B. subtilis* does not; and therefore that the nitrous acid reactions which he obtained in the case of the two former organisms must obviously have been due to the reduction of the nitrate in the urine, and not to oxidation of ammoniacal nitrogen, as he supposes. That nitric nitrogen is an invariable constituent of human urine has been shown by Warington (Trans. Chem. Soc., 1884, p. 669), and has in fact been long known." Frankland summarizes his results as follows: "8. None of the organisms under examination were found capable of oxidizing ammoniacal nitrogen to nitrous or nitric acids, when introduced into a nutritive solution containing ammonium chloride."

This emphatically negative result with pure cultures of single species was directly confirmed by Warington, who wrote: "It seems to me very clear that not one of the investigators who have experimented with isolated species of bacteria has obtained in his solutions more than a trace of nitrous or nitric acid; no one has obtained an amount that could be determined quantitatively. Another point which generally appears is that every organism tried gives nearly the same result. . . . The statement of Heræus that seven of the organisms examined commenced the nitrification of a twenty per cent urine solution in one day is apparently due to a mistake. My own experiments show that a urine solution of that strength cannot be nitrified by soil without the addition of gypsum; the commencement of nitrification in a strong solution is also extremely slow. The nitrous acid which so speedily appeared in his solutions was due to the reduction by the organs of the nitrates naturally present in the urine" (Journ. Chem. Soc., August, 1888, Vol. LIII., p. 727). Of his own experiments, he says: "A distinct reaction with diphenylamine was in some cases obtained, but this did not appear to grow in amount, although in such cases the examination was specially prolonged. The amount of nitric or nitrous nitrogen in the solutions did not apparently in any case exceed one per million, and all of this could not be attributed to the action of the organism, as the unseeded solutions in the incubator also gave some reaction with diphenylamine. When we have discounted the trace of nitrites probably obtained from the atmosphere, there is clearly very little left that can be attributed to the action of the organism. The question whether any part of the nitrate or nitrite present was produced by the organism, I am unable to decide; but it is quite clear that none of the organisms examined possessed any nitrifying power in any way comparable with that possessed by soil. An organism which nitrifies as soil nitrifies has yet to be isolated."

There are thus several views which are held regarding the action of individual species of bacteria on nitrogenous solutions: —

1. That there is a group of bacteria capable of oxidizing ammonia to nitric acid, and another and separate group able to reduce nitrates to nitrites in the presence of organic matter. Both kinds are widely and abundantly distributed. Attendant circumstances determine whether the reducing or the oxidizing group will gain the upper hand (Heræus).

2. That all kinds of bacteria, under favorable circumstances, are capable of producing nitric acid, and that the same organisms in the presence of organic matter are capable of reducing nitrates (Celli and Zucco, Leone).

3. (*a*) That different species of bacteria vary greatly in their ability to reduce nitrates; and (*b*) that there is no reliable evidence that any individual species is able to oxidize ammonia either to nitric or nitrous acid (Warington, Frankland).

Such is a brief sketch of the divergent opinions upon nitrification which were held at the time we began our work in the autumn of 1888. It seemed to us important to approach the subject from all sides, and we have worked accordingly not only with pure cultivations of bacteria, but also with various sands, soils, and waters containing mixtures of several kinds. We have considered it of fundamental importance to determine the distribution of the nitrifying organism, and, if possible, to ascertain the relative frequency with which it occurs over a wide area. The question, for instance, naturally arose, is the nitrifying organism present in the Boston city water as delivered from the tap in the laboratories of the Massachusetts Institute of Technology, since this is the water used in making up our solutions. To this question we are able to give a decided affirmative. Ammoniacal solutions carefully made with tap water always nitrify. Moreover, ammoniacal solutions which have been sterilized and then inoculated with a cubic centimetre of fresh tap water always nitrify. Repeated experiments show that the nitrifying organism is invariably present in this water. When, however, ammoniacal solutions were inoculated from the separate colonies appearing on a gelatine plate culture of this water, in every instance there has been obtained only a negative result. To this matter of inoculation with pure cultures of bacteria we shall recur presently.

In many of our early experiments upon nitrification we used a mixture of one cubic centimetre of fresh urine with two litres of tap water. This mixture was found to yield, when freshly made, about .5000 free ammonia, .2000 albuminoid ammonia, .0002 nitrites, and .0250 nitrates, in 100,000. This nitrogenous solution was allowed to stand at the temperature of the room (21°–23° C.), and was tested from time to time for nitrites and nitrates. The method used for the determination of nitrites has been Griess's naphthalamine method. This method is sufficiently delicate to detect the presence of one part of nitrogen as nitrite in one thousand millions. The method for determining nitrites is a modified form of the phenolsulphonic method of Grandval and Lejoux.

If the nitrogenous solution be first sterilized and then inoculated with fresh tap water, the same course is followed, with the exception that the period of incubation is considerably lengthened. If seeded with sand from a sewage filter tank, or with garden soil, the whole process is materially quickened, and may even be wholly completed in thirty days.

Not only is the nitrifying organism present in Boston tap water, as the above experiments clearly demonstrate, but it appears to be equally common in water from all parts of the State of Massachusetts. So far as our experience has gone, any natural water, containing the ordinary amount of free or albuminoid ammonia, contains also the nitrifying organism, as is shown by our long series of tests. In these natural waters the nitrifying organism seems to be under wholly normal conditions, and to be abundantly able to effect the oxidation of the small quantities of nitrogen usually present in these waters. Waters that contain high albuminoid ammonia, in cases where this ammonia comes from the nitrogen in infusoria, algæ, etc., go through the same changes as those which contain free ammonia, but more slowly. The organisms in time die, the bacteria set free the nitrogen of their bodies, forming free ammonia, and then in turn nitrites and nitrates.

It might, perhaps, be reasonably expected that, since the nitrifying organism is undoubtedly present in all these waters, an examination of gelatine plate cultures of these waters would reveal some particular kind or kinds of colonies common to all, and in that way aid in sifting out the nitrifying organisms. Our experience has shown, however, that such a hope is unfounded. So far as the inspection of gelatine plate cultures enables us to judge, no one kind of colony is common to all these waters. This fact, on the surface, seemed to favor the view that the power of nitrification was not the property of any particular organism, but was very likely possessed in common by a number of kindred species.

The other line of bacteriological work — the inoculation of nitrogenous solutions with pure cultures of isolated bacteria — has been followed up from the outset, and was begun with full confidence in ultimate success. It is unnecessary to give a detailed account of our experiments in this direction. It is sufficient to say that the nitrogenous solutions have, from beginning to end, failed to nitrify. Nitrogenous solutions of various sorts have been used, pepsin solutions, peptone solutions, ammonium chloride solutions, Frankland's solution (Zeitschr. für Hygiene, Bd. VI., 376), etc., all with the same unfailingly negative result. A large number of species of bacteria have been used for inoculation, not only well-known species like *B. prodigiosus*, *B. megaterium*, *Proteus*, etc., but many species freshly isolated from water, sewage, the sand of nitrifying filter tanks, and similar favorable situations for the nitrifying organism. The experiments have been always prolonged for several months, and in some cases for more than a year. Conditions of temperature, amount of surface exposed to the air, etc., have been varied in many directions. Nitrogenous solutions containing a single species of bacterium have been poured upon sterilized sand, and allowed to settle in such a way as to imitate closely the conditions obtaining in filter tanks. In all, more than one hundred and fifty experiments have been made, covering a period of two years. In every case, without a single exception, there was not the slightest evidence of nitrification by any single species.

There still remains a plausible explanation of this striking succession of negative results. It might be that, although any one species working alone was not able to effect nitrification, a number of different species working together might be able to produce the desired result. This was certainly not an unreasonable supposition, judging from analogous fermentative processes; co-operation and combination might perhaps effect more than individual and independent action. Several experiments were accordingly made with a view of determining this point. Here again the results were invariably negative. Ammoniacal solutions, inoculated with mixtures of several species under pure cultivation, always failed to nitrify. In one experiment, for example, a nitrogenous solution, found by experience to nitrify rapidly and completely when seeded with garden soil, was inoculated with a mixture of six different species of bacteria. These six species were all isolated from soils and waters known to contain the nitrifying organism. An examination of the solution from time to time, by the method of gelatine plate culture, showed a vigorous growth on the part of all the species, but there was at no time the slightest evidence of nitrification, although the experiment continued for upwards of five months.

In the course of our experiments we have found it necessary to guard against two possible sources of error. We noticed at the outset a tendency in all our solutions, whether inoculated with pure cultures, or entirely free from bacteria, to show an increasing quantity of nitrogen as nitrite. This increase of nitrite in standing solutions is shown in the following instance. A nitrogenous solution, placed in a flask stopped with cotton wool, was sterilized in the usual way, and allowed to stand in the laboratory. At first no nitrogen in the form of nitrite was present, but after one month .003 parts per 100,000 had appeared, and at the end of three months .008 parts of nitrite were present. In some cases a much larger amount than this appeared, although no bacteria were in the flasks. In all these instances nitrite was undoubtedly absorbed from the air of the laboratory. Sterilized distilled water was found to absorb nitrite with the same rapidity as did our nitrogenous solutions, in one case absorbing .0015 in a few days. If the solutions were protected from the free access of air, no increase of nitrite was noted, and there was also no increase if they were removed to a room in which little or no gas was burned. In rooms in which much gas is burned it is obvious that, with the present refined methods for detecting nitrites, this absorption from the air, unless guarded against, may lead to erroneous conclusions. This fact of nitrite absorption from the air has been already noticed by Warington and other observers.

A second possibility of misinterpretation lies in the reduction of the nitrates that may be present in the solution. This reduction takes place even when the quantity of nitrate and organic nitrogen is small, although more slowly than is the case in the presence of considerable quantities of organic nitrogen. In one example there were no nitrites and .036 nitrates present at the beginning of the experiment in the sterilized solution. On inoculation with a certain bacterial species, afterward found to possess a reducing action, the quantity of nitrogen as nitrite increased in a short time to .0256, while the nitrate diminished to .015. On another occasion, with .036 initial nitrate, the nitrites rose from nothing to .021, and the nitrates disappeared proportionally. If larger amounts of nitrate are present, the increase of nitrite is more striking. Certainly this reducing action of many species of bacteria will go far to explain such results as those reached by Heræus (*loc. cit.*).

An interesting experience, and one very significant in the light of our further investigations, should here be mentioned. A nitrogenous solution prepared in the usual way was inoculated with a certain species, — *Bacillus ubiquitus*, — and examined from time to time, both chemically and bacterially. The solution, on standing for several months, nitrified completely, and the gelatine plate culture showed the presence of a pure culture of *B. ubiquitus*. We naturally concluded that we had discovered a nitrifying organism; but repeated inoculations with a culture of this same organism, both from the flask that had nitrified and from the original growth in a test-tube, gave a negative result. No better success was had with the same organism freshly isolated from water or soil. No explanation of this perplexing occurrence could be given at the time, but subsequent events made it probable that our assumed pure culture was not a pure culture at all, but a mixture of the nitrifying organism and *B. ubiquitus*. Whether the nitrifying organism was introduced from the air, or, as seems more likely, accompanied the first inoculation with *B. ubiquitus*, is unknown. Possibly some of the investigators who have claimed a positive result with species of bacteria grown on gelatine may have been misled in a similar way.

There was, as has been intimated, one possible explanation of our failure to reach consistent positive results by the use of species of bacteria isolated by the method of gelatine plate culture. It might be that the nitrifying organism did not grow on gelatine. Everything seemed to point in this direction, and the belief was further strengthened by a very significant fact observed about this time. We had known for some time that in the history of the filter tanks at the Lawrence experiment station speedy nitrification was always coincident with a marked decline in the numbers of bacteria. The effluents discharged from the filter tanks, although high in nitrates, were low in bacteria; and, moreover, the more complete the nitrification, the fewer were the bacteria in the effluent.

We also observed, that, in an ammoniacal solution which is seeded with ordinary pond water containing several species of bacteria, there is during the first few days a rapid multiplication of the contained germs. Nitrification, however, does not as a rule begin until from ten to fourteen days have elapsed. By the time nitrification begins, the numbers of bacteria, as shown by gelatine plate cultures, have begun to decline; and, while the nitrogen in the form of nitrites in the solution is increasing, the numbers of bacteria are steadily diminishing. Thus, in one instance, an ammoniacal solution, four days after its inoculation with a cubic centimetre of Cochituate water, contained 3,762,000 bacteria per cubic centimetre. Nitrification had not yet begun. When the first signs of increasing nitrites appeared, the numbers of bacteria had sunk to 19,200; and when the nitrites reached their maximum, the bacteria, shown by gelatine plate cultures, were only 9,454. It was certainly difficult to understand why nitrification, a process apparently dependent upon the life and activity of bacteria, should seem to flourish best under conditions in which bacteria were perishing. If, however, it were assumed that the nitrifying organism could not grow in the usual gelatine media, all the perplexing results above recorded could be more easily explained. Under these circumstances it was natural for us to make such an assumption.

There was, of course, the possibility that the nitrifying organism, by its growth on gelatine, had lost its peculiar property; but it did not seem to us likely that so fundamental a property could be parted with in so short a time. However that might be, we determined to test the other hypothesis first, since we believed it to be the more probable of the two. Accordingly, experiments were begun to attempt to isolate the nitrifying organism by the method of dilution. This is the method that was commonly used by investigators in bacteriology before the invention of solid culture media. It has, as is well known, serious practical as well as theoretical drawbacks. In our practice a small portion of an actively nitrifying solution is transferred on the loop of a sterilized platinum needle to a sterilized ammoniacal solution, and when nitrification is thus induced in the second solution a fresh transfer is made from this to a third, and so on. Rigid precautions have been taken to avoid the introduction of foreign germs.

Hardly were these experiments well under way, before our interest in this method of procedure was stimulated by the publication of communications by Percy F. Frankland and Grace Frankland, and by Robert Warington (Chemical News, Vol. LXI., p. 135).

The Franklands, having reached a conclusion similar to our own regarding the behavior of the nitrifying organism in gelatine, had also attempted to isolate the nitrifying organism by the dilution method, and had succeeded in this attempt. They state, in their abstract of the paper read before the Royal Society, that, "after a very large number of experiments had been made in this direction, the authors at length succeeded in obtaining an attenuation consisting of about $\frac{1}{1000000}$ of the original nitrifying solution employed, which not only nitrified, but, on inoculation into gelatine-peptone, refused to grow, and was seen under the microscope to consist of numerous characteristic bacilli, hardly longer than broad, which may be described as bacillo-cocci."

Warington's communication entirely confirms that of the Franklands, in so far as it relates to their earlier and negative results. He had not, however, at the time of writing, succeeded in isolating the nitrifying organism.

A paper by Winogradsky followed soon after. He appears to have discovered independently a nitrifying organism, and attributes his success largely to his microscopic examinations of the nitrifying solutions, and to his use of solutions devoid of organic matter. The following is the composition of the liquid adopted by him: ammonium sulphate, 1 gram; potassium phosphate, 1 gram; water from the lake (at Zurich) 1,000 grams. Each portion of 100 cubic centimetres received in addition .5 to 1 gram of basic magnesium carbonate, suspended in distilled water. Winogradsky found that this layer of magnesium carbonate at the bottom of each flask afforded an excellent gathering place for flocks of the nitrifying organism. The "nitric ferment" does not, as the Franklands had already shown, grow well upon ordinary gelatine plate cultures; and this is probably the cause of the failure of all previous experimenters to isolate the special ferment.

Before receiving Winogradsky's paper, in the spring of 1890, we had been using in our work, at the suggestion of Mr. Allen Hazen, an ammoniacal solution of the following composition: ammonium chloride (resublimed), 1.907 grams; sodium carbonate, 3.7842 grams; sodium phosphate, .2 grams; potassium sulphate, .2 grams. These salts were dissolved in such a quantity of re-distilled water that the solution contained 100 parts of nitrogen per 100,000, and two equivalents of alkali. Ten cubic centimetres of this solution were mixed with one litre of re-distilled water, and then inoculated as desired. The flasks used have been made chemically clean by boiling with potassium permanganate, and the water used has been twice distilled. The other rigid precautions absolutely necessary in all work of this character have always been taken. The solutions thus prepared have contained from .0001 to .0010 parts per 100,000 of albuminoid ammonia.

Proceeding with this solution by the method of dilution, we at length succeeded in isolating a nitrifying organism. A flask was first inoculated with a few grains of sand from Tank No. 13, at the Lawrence Experiment Station, and when nitrification was at its height in this solution, a small portion was transferred from this to a second flask, and so on. After a large number of unsuccessful attempts, two solutions were finally obtained which nitrified well, but gave no growth upon ordinary gelatine plate cultures, although the plates were allowed to stand for seven days. Microscopic examination of these solutions showed them to be inhabited by a particular form of bacillus, and apparently by that alone. These bacilli are short, of a slightly oval shape, and vary from 1.1 μ to 1.7 μ in length; they are about .8 μ to .9 μ broad. They are grouped very characteristically in irregular clumps, and are held together by a jelly-like material. Each aggregation is indeed a typical zoögloea. The aggregations of bacteria were found chiefly on the bottom of the flasks, as was also the case with the organism described by Winogradsky. These masses of zoögloea, obtained as a pure culture from a nitrifying solution, resemble significantly the zoögloea discharged in considerable quantities from the filter tanks at Lawrence. The bacilli stain with some difficulty with the usual aniline dyes. We have not observed independent movement. Owing to the lack of the usual means of diagnosis, it is difficult to determine in a short time whether this species is the same as the one described by the Franklands and by Winogradsky. On one important point there appears to be a difference between our results and those reached by the above-mentioned investigators. The organism discovered by them oxidizes ammonia to nitrite, but carries it no further. Our own flasks give complete oxidation to nitrate. Whether this be due to a difference of conditions, a difference in the virility of the organisms, or a specific difference in the bacteria, we are not at present prepared to say. The short time at our disposal has made it impossible to settle this and many other questions to our own satisfaction. We are not even prepared to say that there may not have been a mixture of two or more species in our flasks, all agreeing closely in morphological characters, and in giving no growth on gelatine, but differing in important physiological respects. Further investigation is necessary to settle this and other important points regarding the relations of this organism to the process of nitrification.

Whether or not we accept the views of Winogradsky, it is certainly worthy of remark, as he observes, that an organism should exist, which, without chlorophyll and in the apparent absence of organic nitrogen and of organic carbon, should be able to multiply and thrive upon wholly inorganic compounds. It may be well doubted, we think, whether this is really the case. It seems more reasonable to suppose that exceedingly minute quantities of organic nitrogen and carbon are actually present, and escape detection by our present methods of chemical analysis, although in reality sufficient to nourish generations of bacteria.

Our own experience, as well as that of previous investigators, seems to be a warning against a too confiding use of the gelatine plate culture in bacteriological work, since in this instance such confidence has left us for a long time in ignorance of a common and widespread as well as highly important organism.

THE PARASITE OF QUARTAN AGUE.

IN the *Zeitschrift für Hygiene* (x. 137) appears the first of a series of papers by Camillo Golgi, demonstrating by means of photography the development of the parasite found in malarious fevers. This paper, of which an abstract appears in the *British Medical Journal*, deals with the *amœba malariæ febris quartanæ*, the form found in the quartan type. In 1880 Laveran stated that these parasites are present in every case of malaria, and in no other condition, and that they are probably the cause of the disease. His observations have been confirmed by pathologists in all parts of the world, and at the present time the weight of proof seems to be in favor of his contention. In his paper Golgi claims to have been the first to demonstrate that the different forms described as occurring in the blood are simply modifications of one form, and, further, that these metamorphoses follow each other according to a fixed law. This development takes place within, and leads to the destruction of the red blood corpuscles.

At first the amœba-like parasite is small and non-pigmented; it increases in size at the expense of the substance of the blood corpuscles, becomes pigmented, and, after passing through a series of metamorphoses, finally ends in a process of segmentation. This process of segmentation takes place at the same time as, or a short time before, the onset of the febrile paroxysm, and has for its object the formation of a new generation of the parasites. The pigment granules stored up in the body of the parasite take no part in this process of segmentation, and hence, on its completion, escape into the blood plasma, where they are seized upon by the white blood corpuscles and cells of the liver, spleen, etc.

The new brood of parasites at once pass into fresh red blood corpuscles, and so commences anew the cycle of metamorphoses leading up to the next paroxysm of fever. The period of time which elapses between the entrance of the parasites into the red blood corpuscles and their segmentation is exactly three days, and hence arises the periodicity of the quartan type of malarial fever. During the first and second days the parasite passes through the various phases of its development within the blood corpuscles, on the third day segmentation takes place, the new brood is set free, and fever results; in other words, the period of apyrexia corresponds with the endoglobular growth of the parasite.

Golgi states that a knowledge of these developmental stages is of immense practical importance for the purpose of diagnosis, by which an almost mathematical degree of accuracy can be arrived at, and that it is no exaggeration to say that by the simple microscopic examination of a few preparations of blood the physician is in a position to tell when the last attack of fever occurred, to foretell the time of the next attack, and further, to recognize what type of malarial fever he is dealing with. The simple quartan fever is explained by Golgi as resulting from the development in the blood of one set of the parasites, which ripen every three days, while the double and triple quartan fevers are caused by the development of two and three sets respectively, coming to maturity on consecutive days. This hypothesis, of course, cannot apply to the tertian type of malarious fever, since in this the febrile paroxysms follow each other with an interval of only one day of apyrexia intervening, instead of two days as in the case of the quartan type.

Golgi is of the opinion that he has brought forward satisfactory evidence to show that tertian ague depends on the presence in the blood of a distinct variety of the malaria parasite, which passes through its developmental phases in two days instead of in three. In regard to classification, Golgi holds that the various clinical types of intermittent fever are caused by varieties of one and the same parasitic species, and that this belongs to the genus amœba. The twelve photographs which illustrate his first paper deal with the development of the parasite of quartan fever, and show, surrounded by normal red blood corpuscles, its successive metamorphoses. The photographs, which are very fine, were taken by means of Zeiss's microphotographic apparatus.

LETTERS TO THE EDITOR.

On some Extinct Vertebrata from the Miocene Rocks of the North-west Territories of Canada recently described by Professor Cope.

AMONG the more recent and interesting additions to the collections in the National Museum, Ottawa, Canada, are the mammalian and fish remains from the tertiary rocks of the Canadian North-west. These collections which were made by Messrs. McConnell and Weston especially have been recently studied by Professor E. D. Cope of the Academy of Natural Sciences, Philadelphia. The results of his observations will soon be made known in a memoir now in print, and to be published by the Geological Survey Department. The specimens in question are now on exhibition in the upright cases of the museum, and from the labels attached the following interesting forms are noticed as of special interest.

Extinct Rhinoceros (*Menodus angustigenis*). — This is the name which Professor Cope has given to the largest species of hoofed animal analogous to the rhinoceros that has ever yet been discovered, and which in early tertiary times was roaming in the then existing forests of the now treeless prairie regions of Canada.

The best portion of the skull of one individual may be seen, about three feet long and eighteen inches across, with the frontal bones and snout preserved; also the two horn-cores and portions of the upper jaw, with several huge molars *in situ*. The lower jaw of the same individual was also found, and the teeth beautifully preserved. Some of these teeth are nearly four inches across and three inches in thickness, being nearly four inches in length, with zig-zag and sharply-cut crowns. The humerus, femur, tibia, many horn-cores, and bones of the pelvic arch and of various other portions of the skeleton, were also found, making in all a beautiful display of fossil bones belonging to as huge and ferocious a beast as prowls to-day in the jungles of an African or Indian forest. Besides this form of *Menodus*, Professor Cope has recognized a number of others, to which he has given separate specific designations, so we find that there existed in Canada not only this huge and ferocious species of *Menodus*, but other allied creatures. These include *Menodus syceras* Cope, *M. Proutii* Owen, *M. Americanus* Cope, and *M. Selwyni* Cope. They all belong to miocene tertiary strata occurring in the vicinity of Swift Current Creek, North-west Territory. These all belong to the family of the *Titanotheridæ*, and form a group of animals analogous to the rhinoceros.

Extinct Horse (*Anchitherium Westoni* Cope). — This is one of the forms which belong to the *Palæotheriidæ*, a family of extinct animals whose affinities seem to place them foremost as the ancestors of the *Equidæ* or horses.

Extinct Boar (*Elotherium Mortoni* Leidy). — Among the specimens on exhibition and collected by Mr. Weston may be seen an almost perfect lower left ramus of this extinct mammal, allied to the modern wild boar and pig, and belonging to the family of the *Chœropotamidæ*. This creature was of huge dimensions, the specimen of the jaw in question being nearly ten inches in length. The teeth are beautifully preserved in a spotted grey and yellow-white lime-rock. This is the first time that this form has been found so far north on the American continent.

Extinct Deer (*Leptomeryx mammifer* Cope). — This new species, a member of the family of the *Tragulidæ*, appears to be one of the ancestors of the deer tribe, being both a ruminant and ungulate mammal. A very well preserved portion of the lower jaw, with several teeth *in situ*, has permitted Professor Cope to establish its relations and affinities, and it forms a valuable addition to the fauna of those times which preceded the advent of the great ice age, when all these types disappeared and made room for the mastodon, the mammoth, and other creatures, including the megalonyx and its allies.

Other Extinct Forms. — Besides the above may be seen a large incisor belonging to a large *carnivore* allied to the modern dog or wolf; the tooth of an oreodont, an extinct hare (*Palæolagus turgidus* Cope) belonging to the family of the *Leporidæ;* also a species of *Trionyx* which Professor Cope has called *Trionyx leucopotamicus*, from the fact that similar forms occur also in the White River series of formations in the southern territories of the United States. But besides the above we find also extinct forms allied to the squirrels (*Hypertragulus riversus* Cope), and also a large number of bones of siluroid fishes belonging to the genera *Amiurus*, *Rhineastes*, etc. Among these we find *Amiurus McConnelli*, *A. cancellatus* (all described by Cope); also *Amia macrospondyla*, *Amia Selwyniana*, and *Rhineastes rhœas* Cope.

Fossil Turtles. — Then come the remains of a species of *Stylemys*, an extinct turtle belonging to the family of the *Testudinidæ*, one of the *Chelonia*.

Chalicotherium and *Hempisalodon.* — The latter form (described under the name of *H. grandis* Cope) affords another example of an extinct type of hyena, much larger than any of the modern living ones. It belongs to the family of the *Hyænodontidæ*, and forms a part of a sub-order of that family with very large representatives. The genus *Chalicotherium*, one of the family of the *Chalicotheriidæ* Lydekker, has certain affinities to the rhinoceros, whose size and proportions it greatly resembled.

Thus it will be seen that from the miocene tertiary strata of the Swift Current River, not far from the line of the Canadian Pacific Railway, along the treeless prairie region of Canada, a large fauna existed, some of whose remains now adorn the cases of the National Museum at Ottawa. HENRY M. AMI.

Ottawa, Ont., July 6.

Osteological Notes.

AMONG the primates, the *Anthropomorpha* (higher apes) have strong jugal arches, longer than in man, and presenting marked horizontal and vertical curvature. Although properly composed of only two bones, viz., the zygomatic process of the squamosal, and the jugal, this last rests upon a process of the maxilla so much developed that in many cases it might be rightfully considered as entering into the formation of the arch. The suture which joins the squamosal and the jugal is long and serrated, its great inclination downwards and backwards vastly increasing the strength of the parts as well as the power of resistance.

In the gorilla the jugal arch is relatively broader and more developed than in the other higher apes. The process of the squamosal presents a sudden vertical convexity upon its upper border, at a point corresponding to the junction of the anterior transverse root, the remaining portion of the arch being nearly of the same width. The breadth of the channel for the play of the temporal muscle is proportionally large. The entire structure of the arch, especially in its horizontal and vertical curvatures, exhibits enormous strength. In the adult male all the cranial ridges attain their maximum size, thus presenting a largely increased surface for the origin of the temporal muscle, while the relative greater breadth of the ascending ramus of the mandible, and the increased width of the pterygoid fossæ are correlated with a corresponding development of the masseter and pterygoid. The long and massive canines so characteristic of the higher apes, especially of the gorilla and orang, have reference to the powerful action of the last-named muscles. Their use has also a sexual relation. The glenoid cavity is transversely broader than in man, and more shallow, its anterior boundary, formed by the inferior root of the zygoma, being scarcely developed, allowing greater freedom for the antero-posterior movement of the articulation of the mandible.

In comparing the skull of the male gorilla with that of man, — a male negro, for example, — we shall find the jugal arch of the former to be built upon a vastly stronger plan, both the squamosal and the malar presenting different forms and proportions. The squamosal is as long and vertically as wide as the malar portion of the arch, while its upper border rises into an angular form, constituting a very marked convexity, no trace of which is to be seen in the negro. In the latter the jugal portion of the arch decreases in depth after leaving the body of the bone, whereas in the gorilla it continues of the same depth and is also longer.

In the orang, the horizontal curvature of the arch is greatly produced, and strongly developed at the portion corresponding to the malar-squamosal suture. Its inferior border is flattened and thickened. The vertical curvature, however, is not so great, while the channel for the temporal muscle is relatively wider than it is in the gorilla. The crests and ridges of the cranium, especially in the male, express the great energy of this muscle, although the general outline of the arch is far less massive than in the latter ape.

The jugal arch of the chimpanzee's cranium presents much resemblance to that of man, being narrow, and with slight curvature either horizontal or vertical. The malar is anteriorly flatter, and its orbital process is longer and narrower at its base. The extent of surface for the development of the temporal muscle is greater than in man, and the width of the channel relatively increased.

The slight modifications observed in the jugal arch of the gibbons (*Hylobates*) exhibit a distinct tendency to those shown in the lower type of the *Simiana*, the monkeys. In these last, the old-world monkeys (*Catarrhinæ*), the arch takes on a sigmoidal curvature, thus presenting upon its superior border a slight convexity behind and a corresponding concavity anteriorly. The extent of this curvature varies in different groups. In the new-world monkey (*Platarrhinæ*) the post glenoid process of the squamosal is largely increased, while the remarkable extent of the ascending portion of the ramus, both vertical and antero-posterior, has reference to the great development of the vocal organs in the howling monkeys (*Mycetes*) rather than to any unusual energy of the masticatory muscles.

In the *Lemuroidea*, the family of the common lemurs (*Lemurinæ*) have an arch which in most cases is nearly straight, narrow, long, and distinguished by a malar-squamosal suture which is almost horizontal in direction, the amount of the overlapping of the jugal by the lengthened process of the squamosal being exceptional, while in some cases the jugal is partially underlapped by a process from the maxillary.

In studying the significance of the jugal arch as presented in the primates, although the modifications exhibited in some groups

Publications received at Editor's Office, July 15-21.

BRENTARI O. Guida del Trentino. (Societa degli Alpinisti Tridentini XV. Annuario.) Bassano, Premiato Stabil. Tipogr. 459 p. 16°.
CARHART, H. A. Primary Batteries. Boston, Allyn and Bacon. 193 p. 12°. $1.50.
DRAYTON, H. S. Vacation Time, with Hints on Summer Living. New York, Fowler & Wells Co. 84 p. 12°. 25 cents.
GUYAU, J. M. Education and Heredity. (Contemporary Science Series.) New York, Scribner's. 306 p. 12°. $1.25.
MARILAUN, A. K. v. Algemeine Naturkunde. Lief. 124-129. Pflanzenleben, II. heft. 7-12. Leipzig, Bibliog. Institute. 336 p. 4°. (New York, Westermann.)
MERCANTILE Journal, the. Vol. I., No. 1. w. Chicago, J. A. Brewer & Co. 8 p. f°. $3 a year.
PILSBRY, H. A. Sea Shells of the Jersey Shore. Asbury Park, N. J., A. P. Novelty Co. 40 p. 16°.
ROYAL Society of Canada, Proceedings and Transactions of the, for the year 1890. Vol. VIII. Montreal, Dawson Bros. 632 p. 4°.

of the order cannot readily be explained, the principal laws which govern its morphology, and which have been noted in previous papers, are sufficiently evident. These are, that the development of the arch, as shown by the number of bones, by the degree and form of its curvature, by its relation to the orbit and articulation of the mandible, as well as to other neighboring parts, and the amount of surface presented for muscular development, are correlated with the energy of the masticatory power, joined in some of the higher apes with a prehensile strength of jaws and dental series eminently characteristic of their ferocity.

D. D. SLADE.

Cambridge, Mass., July 11.

AMONG THE PUBLISHERS.

THE J. B. Lippincott Company, Philadelphia, have in press, and will publish early in the fall, "A Supplement to Allibone's Critical Dictionary of English Literature and British and American Authors," by John Foster Kirk. The work contains over thirty-seven thousand articles (authors), and enumerates over ninety-three thousand titles. It will be published in two volumes, large 8vo size, and will comprise about sixteen hundred pages.

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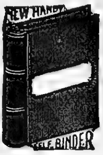

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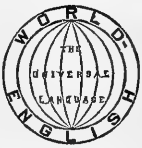

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SCIENCE

NEW YORK, JULY 31, 1891.

THE UPPER STRATA OF THE ATMOSPHERE.

AT a meeting of the Geographical Society of Berlin on May 2, 1891, Professor Förster read a paper on "The Upper Strata of the Atmosphere," a report of which is given in the Proceedings of the Royal Geographical Society for July. Professor Förster began by saying that the earlier conceptions of the height of the earth's atmosphere were based mainly upon observations as to the duration of the twilight, and as to the extent to which the light of the heavenly bodies was refracted. On the basis of such observations, the height of the atmosphere was estimated at from forty to fifty miles; it was not, however, by any means thought that, above these altitudes, there were no other strata belonging to the earth, but only that the density of the latter was too small for them to produce the optical effects just specified. The discovery of a means of determining the existence of such extremely thin strata beyond a height of fifty miles dates from the end of the eighteenth century, when attempts were first made to measure, according to Chladni's principles, the heights at which the first illumination of falling stars takes place.

A specially comprehensive investigation with reference to these heights was carried out at the instance of the Berlin Observatory in August, 1867, by means of simultaneous observations in the neighborhood of Berlin, with the result that not one of the altitudes at which illumination commences, and which were measured with sufficient accuracy, was found to exceed practically a hundred miles. These results, however, possess only a relative value, being valid only for the falling stars of the month of August, the so-called Perseides; for it is evident that illumination will arise earlier or later, and at different altitudes, according to the varying velocities with which the small heavenly bodies penetrate the atmosphere. Illumination will take place earliest in the case of those falling stars which move in a directly opposite direction to the movement of the earth, which travels at about nineteen miles per second. These heavenly bodies, possessing a velocity of their own of about twenty-six miles per second, consequently enter the earth's atmosphere with a velocity of forty-five miles; while in the case of those bodies which tend to be overtaken by the earth in their movement round the sun, the velocity can, in the most extreme case, only be equal to the difference between the two velocities above-mentioned, viz., seven miles.

The altitudes at which extinction, that is to say, the almost complete dissolution of these heavenly bodies, commences, vary very much, because the rapidity of the extinction is dependent upon the size and composition of the bodies themselves. The Berlin observations of 1867 gave for this an average height of about fifty miles. From these observations as to falling stars it is also supposed that the boundary between the strata which participate in the earth's movement and those which resist it should be fixed at least at some miles higher than a hundred miles. It is here also that the bodies become heated prior to their illumination.

The polar lights extend to still greater altitudes; their height, at the time of their greatest development, when they are visible as far as the tropics, would be from 300 to 375 miles, while in the polar regions they spread themselves, as a rule, at a height of only a few miles, indeed quite close to the earth's surface. But there remains the question whether at those altitudes there are still strata which follow the movement of the earth round the sun; for it is possible that the phenomena of the electric glow, which the polar lights may be considered to be, radiate from the earth into the heavens, follow also the earth's movement round the sun, but at the same time extend beyond the strata belonging to the earth into the strata of extremely rarefied gases, which in all probability fill up the space between the planets and the sun. This space may be designated as the "Himmelsluft," and is not to be confounded with the so-called "ideal medium," viz., ether, in which luminous phenomena are supposed to occur.

Evidence in support of the existence of such a "Himmelsluft" is to be found in the conditions existing on the sun, which are gradually becoming more completely known. On the sun, gases are continually being developed and given off as the result of explosive processes as well as of the dissolution and volatilization of the numerous small meteoric bodies which are incessantly hastening to the sun. Further, the movement of Encke's comet, which, in its return, occurring in periods of twelve hundred days, remains longest in the vicinity of the sun, has furnished important evidence of the obstructive effect of a so-called "Himmelsluft." The movements of other comets and of the planets have not yet afforded evidence of such an influence, but it must be borne in mind that the perceptibility of such an effect depends not only on the density, which increases towards the sun, but also on the proportion which the surface of the heavenly body in question bears to its mass. This proportion is very much greater in the case of comets than in the case of planets, and may also in one comet be much greater under certain conditions than in others.

Indications of the counter-influence of the relatively quiet "Himmelsluft" as compared with the earth, which rushes through it with a velocity of about nineteen miles per second, can be recognized in the highest strata in the case of the movements of the luminous tails and clouds of light which many falling stars and fireballs leave behind them along their flying course, that is, when these remain visible for some minutes. The changes of position and form, which proceed apparently very slowly in these luminous forms, due regard being paid to their great height and distance from the observer, are supposed to be executed with a velocity of more than sixty yards a second. The movements which take place in these meteoric tails are, according to all appearances, not so simple that they can be explained merely as being the result of the highest strata being left behind in consequence of the velocity with which the observer on the earth's surface is being whirled along, and which at the equator amounts to seventeen miles a minute, and at our latitudes to about eleven miles a minute. The very considerable alterations of form which these tails undergo in shifting their position, point to very complicated conditions of movement. But the counter-influence of "Himmelsluft," as compared with the movement of the earth round the sun, is a necessary consequence, not only of the movements in the highest strata of the atmosphere, but also of the effects of pressure, which could not remain unnoticed in the case of very delicate barometrical measurements. If the daily period of fluctuation of the atmospheric pressure were not influenced by so many different factors, — for example, by the daily warm period and, theoretically at least, by a certain operation of ebb and flow caused by the sun and the moon through their powers of attraction in the atmosphere as well as in the ocean, and perhaps also by the electrical conditions of the atmosphere, — there must be, at that time of day at which a given station arrives, in consequence of the earth's rotation, on the front side of the mighty "vessel" which transports us round the sun with a velocity of nineteen miles a second, a somewhat greater atmospheric pressure. This time of day is, as a rule, between midnight and midday.

In the polar regions the state of affairs is a little more complicated. In these zones an observer can, during the winter, for a longer or shorter period, according to the geographical latitudes, remain on the front side of the earth, while in summer he finds himself turned over on to the back of the earth, viz., on that side which is away from the direction of movement. In lower latitudes the mercury in the barometer must always stand higher during the morning hours than during the rest of the day. In consequence of the collective effect of the various factors which influence the daily period of the pressure of the atmosphere, the result is a very complicated one.

Within the last five or six years a group of phenomena has arisen, which is of the greatest importance in considering the problem of the conditions in the upper strata of the atmosphere. The last of the series of phenomena connected with the Krakatoa eruption are the so-called luminous clouds, which have since that time been observed during the night in the summer months on both hemispheres at a height of about fifty miles. These clouds consist obviously of the smallest molecules of water, which have been projected to their highest point, and which during the summer nights have reflected down upon us from that great height the direct rays of the sun. The long duration of this phenomenon makes it a very remarkable one. During the last two years, for which very accurate photographic determinations of altitude are available, the average height of these clouds has not altered. This can only be explained if we suppose the existence in those altitudes of an opposing force, which nearly overcomes the influence of gravity, in consequence of the giving off of electricity.

In the last few years not only has the density of this collection of matter been very materially lessened, but its geographical and periodical distribution over the different regions of the globe has become more restricted and regular. In Germany these clouds have, during the last three years, only been seen between the end of May and the end of July, towards the north, at a distance of from 310 to 435 miles; on the southern hemisphere, at the southern extremity of America, only during the local summer (December), and then towards the south. It may, therefore, be supposed that this collection of the smallest molecules travels every year from one polar zone of the earth to the other, so that it is found just over that hemisphere where summer is at its height. This periodical movement would be completely unintelligible if the counter-influence of the "Himmelsluft" on those high strata of the atmosphere which participate more or less entirely in the rotation of the earth on its axis and round the sun, did not furnish an explanation. In consequence of the inclined position of the earth's axis, and of the counter-effect of the "Himmelsluft," there occurs from June to December a disposition, reaching its maximum in September, on the part of those strata, to travel from the northern to the southern hemisphere; while from December to June the reverse is the case. It is calculated that for such a periodical journey from pole to pole an average velocity in the north and south direction, or *vice versa*, of only little more than a yard a minute is necessary, a rate which is quite insignificant when compared with the velocity of nineteen miles a second, with which the relatively quiet "Himmelsluft" operates on the upper strata of the atmosphere which move with the earth.

Extensive investigations and measurements are still needed in order to arrive at a result in this matter, and it is only by means of the fullest co-operation of numerous observers in all parts of the world that the necessary data for this purpose will be obtained.

MILK FROM TUBERCULOUS COWS.

ACCORDING to a report by United States Consul Ryder of Copenhagen experiments have been resumed in Denmark towards elucidating the question whether milk from tubercular diseased cows, even in such cases where the udder was not affected with tuberculosis, can be the means of communicating infection. In these experiments the investigation was made in all with the milk from twenty-one diseased cows, with which forty guinea-pigs were inoculated. It had been intended that two guinea-pigs should be inoculated from each sample; but in two cases, owing to the number of these animals having fallen short, only one guinea-pig could be employed, from two to three cubic centimetres of milk being used on each occasion. The milk samples were taken by the veterinary surgeon of the cattle market, the cows being milked by him and the milk caught up into small bottles. The veterinarian selected only such cows as, on examination during life, could be classed by him as suffering in a high degree from tuberculosis; and in every case the udder and chest intestines of the animals were afterwards sent for examination, so as to obtain full assurance of the correctness of the diagnosis, as well as to ascertain the extent of development of the disease. The inoculated guinea-pigs were kept in isolated cages in such manner that only the two which had received milk from the same cow came into contact with each other. Three of the guinea-pigs were killed by rats, fortunately, however, at such distance of time (24 or 25 days) after inoculation that the inoculated tuberculosis must have shown itself had it been present. Two others died of casual (not tuberculous) lung disease after the lapse of a month and a half and two months, having no sign whatever of tuberculosis.

The results obtained from these inoculations are that milk from seventeen of the examined cows had no influence in producing tuberculosis in the guinea-pigs, while the milk from four of the cows showed itself to be communicative of infection; but in three of these cases, on examination of the udder most minutely, this could scarcely be considered in a perfectly sound state. In the one case two small tumors were found of about the size of a pea; in the two others, of the size of a hazel-nut; but in all the cases, with a slight hardening of the tissues in a somewhat extended circuit. When the above-mentioned tumors were cut over, they presented the exact appearance of a fresh tubercular udder inflammation, that is to say, the gland lobes were swollen, firm, and of grayish color, slighly translucent, and with yellow streaks corresponding with the lacteal passages. In dried preparations of tissue from the tumors, as well as from the infiltrated regions, tubercle bacilli could be demonstrated, and sections showed on both sides the presence of typical tuberculous tissue with giant cells containing bacilli. Thus there could be no doubt but that in all three cases a commencement of tuberculosis had to be contended with. The slighter the development of the tubercular attacks in the udder, so much the fewer will be the number of bacilli thrown off from the milk. In full agreement with this, it was found, that, of the two inoculated guinea-pigs, only one was attacked in the case where but two small tumors of a pea-size were found in the udder. The other guinea-pig was killed four weeks after the inoculation and was found to be perfectly sound. In the last of the four cases where the milk was found communicative of infection, no discernible tubercular attack was to be detected in the udder. This case, however, differed in some degree from the others. The cow in question died of tuberculosis of chronic character and in a very advanced stage, several of the organs having been attacked (the lungs, pleura, mesenteric glands, liver, and intestines), while the other cows whose milk had been examined had all been slaughtered. With these the attack had not reached the extreme stage, although in many of them it was found to be far advanced.

While this case would thus seem to prove that the tubercle bacilli can pass over to the milk without the previous existence of any tubercle tissue in the udder, it is at the same time observed that in this case there is all reason for regarding it as one of exceptional character. From the detailed report on these researches it may perhaps be gathered that the matter in question stands somewhat in the following position: If it really be the case that the milk of tuberculous cows is of such great danger as the medium of communicating infection, it might certainly be expected, looking at the great spread of tuberculosis among cattle, that the disease would, at the same time, be conveyed to human beings much more frequently than it seems, in fact, really to occur with the raw milk and (though perhaps in a somewhat less degree) with the dairy produce, especially of butter and cheese. The generally entertained opinion that milk from tuberculous cows, as a rule, only under certain conditions, was really of such dangerous character, would appear to be much more in accordance with the results obtained.

To prevent the conveyance of infection to the human being through the medium of tuberculous cows' milk, it should be the main consideration to watch for the earliest appearance of swelling or tumor of a tuberculous nature in the cow. Such recognition, as a rule, will not be of much difficulty, and at any rate will lead to good grounds of suspicion, such as a firm, painless, and, as a rule, speedily spreading glandular swelling, with the secretion in the first weeks retaining its natural appearance, but later on becoming thinner and more watery, but seldom of a pus nature. The question of danger of infection through the use of such milk is perhaps sufficiently summed up in the following words of the report on these researches, namely, that milk obtained from a tuberculous cow with an apparently sound udder, as a rule, will not be found dangerous; but, at the same time, as in no individual case can it be said with certainty that one may not be dealing with one of the depicted exceptions from the general rule, it would be advisable to regard such milk with suspicion in respect to its infecting powers.

NOTES AND NEWS.

A LONG time ago, says the *Engineering and Mining Journal*, the distinguished French astronomer Flammarion expressed the belief that communication would be established one day between the earth and the planet Mars. The idea seems to have appealed very strongly to the fancy of an old lady at Pau, France, who died recently, bequeathing a legacy of 100,000 francs as a reward to the first scientist who may devise a scheme for successfully accomplishing the feat. The money, which is payable for ten years only, is to be held in trust by the French Institute.

— Silo experience in the United States now covers more than ten years, and so far as the economy of producing silage and the advantages of feeding it are concerned, there appears to be everywhere, among those who have operated successful silos, a strong conviction that good silage is a superior and cheap feed; but the same experience is now fast demonstrating serious imperfections in the construction of perhaps a majority of existing silos in this country. Some silos have so rapidly deteriorated as to become utterly useless for the purpose for which they were intended inside of three or even two years, unless they are subjected to extensive repairs, while others have never successfully preserved the materials placed in them. With a view to obviating these difficulties in the construction of future silos, and of suggesting remedies for the defects of existing ones, a study of the actual construction and condition of silos now in use has been undertaken by F. H. King, physicist of the Wisconsin Agricultural Experiment station. Thus far he has examined ninety-three silos, and the results of his labors, together with valuable suggestions about the construction and repair of silos, are given in the July bulletin of the station named.

— Mr. O. Chanute, a well-known engineer of Chicago, having during recent visits to Europe gathered much information concerning the methods and results of preparing wood chemically to resist decay, says he is confirmed in the opinion that the time has arrived when great economies may be realized by the adoption of these methods on railroads in many parts of this country. He recently examined some experimental railroad ties of the most perishable kinds of wood, prepared by what is known as the zinc-tannin (Wellhouse) process, in St. Louis, in 1881 and 1882, and laid in the tracks of the Atchison, Topeka, & Santa Fe Railroad, as Topeka, Kan., and La Junta, Col. After nine or ten years' exposure they show excellent results, whereas they would have lasted but from one to four years if unprepared. Unprepared ties of the same kind of timber, laid at the same time, adjoining to the prepared ties, have all decayed and been taken up, while present appearances indicate that the prepared ties (red oak, black oak, and Colorado pine) are likely to show an average life of ten to fifteen years or more. Not only does the zinc-tannin process preserve ties against decay, he says, but it hardens them as well. It is found on one railroad that after three years' exposure treated hemlock ties hold the spike as well and cut less under the rail than untreated white oak. He is convinced by experience that on many railroads, where white oak is getting scarce, an economy of a hundred dollars a year per mile of track can be effected by preparing ties of inferior kinds of wood to resist decay by the process mentioned.

— The Leland Stanford Junior University of California has announced the names of the members of its faculty. The professorships in engineering and scientific studies are held as follows: John Casper Branner, formerly of the University of Indiana, professor of geology (work to begin in 1892); Oliver Peebles Jenkins, formerly of De Pauw University, professor of physiology and histology; John Henry Comstock, formerly of Cornell University, non-resident professor of entomology (resident in January, February, and March); John Mason Stillman, formerly of the University of California, professor of industrial and inorganic chemistry (work to begin in 1892); Ferdinand Sanford, formerly of Lake Forest University, professor of physics; Charles David Marx, formerly of the University of Wisconsin, professor of civil engineering; Joseph Swain, formerly of Indiana University, professor of mathematics; Horace Bigelow Gale, formerly of Washington University, St. Louis, professor of mechanical engineering; Charles Henry Gilbert, formerly of Indiana University, professor of vertebrate zoölogy; Douglas Houghton Campbell, formerly of Indiana University, professor of cryptogamic botany; George Mann Richardson, formerly of Lehigh University, assistant professor of inorganic chemistry; Louis Alexander Buchanan, formerly of the St. Louis Polytechnic Evening School, foreman of the wood-working shop; and Daniel Kirkwood, formerly of Indiana University, non-resident lecturer on astronomy (resident in May).

— The necessity of devoting to sleep several hours in each day, says the *Lancet*, is too obvious to admit of serious question. The proper selection of these hours is also, for those who would prolong and usefully employ life, a very needful consideration, though its importance may to some be less evident. We have all met with persons, outside of hospitals and of parliament, who do half or more of their daily work after nightfall, and sleep long after earlier rising men are awake and busy. Some of these are wont to extol the comfort of their morning slumbers. They describe as immense the refreshment they receive from six or seven hours thus agreeably spent, and no wonder, for the sense of present satisfaction must be very marked, and that for definite reasons. Man, in common with most of the animal creation, has accepted the plain suggestion of Nature that the approach of night should imply a cessation of effort. If he ignores this principle his work is done against inherited habit, and, so far, with additional fatigue. It follows, too, from our ordinary social conditions, that he must use artificial light, and sustain its combustion at the cost of his own atmosphere. Naturally, therefore, when he does rest, his relief is in proportion to his weariness. As in many other cases, however, sensation is not here the most reliable guide to judicious practice. Established custom affords a far truer indication of the method most compatible with healthy existence. The case of the overworked and the invalid lends but a deceptive color to the argument of the daylight sleeper. In them excessive waste of tissue must be made good, and sleep, always too scanty, is at any time useful for this purpose. For the healthy majority, however, the old custom of early rest and early waking is certain to prove in future, as returns of longevity and common experience alike show that it has proved in the past, most conducive to healthy and active life.

— The results of an investigation concerning the cause of the insolubility of pure metals in acids, contributed by Dr. Weeren to a recent number of the *Berichte*, are given in abstract in *Nature* of July 16. De la Rive, so long ago as the year 1830, pointed out that chemically pure zinc is almost perfectly insoluble in dilute sulphuric acid. Hitherto, however, the hypotheses put forward attempting to account for this singular fact have been any thing but satisfactory. The theory of Dr. Weeren is extremely simple, and is fully supported by the most varied experiments, physical and chemical. It may be stated as follows: "Chemically pure zinc and also many other metals in a state of purity are insoluble or only very slightly soluble in acids, because, at the moment of their introduction into the acid, they become surrounded by an atmosphere of condensed hydrogen, which under normal circumstances effectually protects the metal from further attack on the part of the acid." It is found that when a piece of pure zinc is immersed in dilute sulphuric acid, a slight action does occur during the first few succeeding moments, zinc sulphate and free hydrogen being formed in minute quantity. The free hydrogen, however, instead of escaping, becomes condensed by the molecular action of the zinc upon the surface of the latter, and is retained there with great tenacity as a thin mantle of highly compressed hydrogen gas, capable of affording perfect protection against further inroad of the acid. The experiments from which this simple and very probable explanation has been derived were briefly as follows. The amount of chemically pure zinc dissolved by the acid was first determined. It was, of course, an exceedingly minute quantity. Considering this amount as unity, it was next sought to determine what difference would be effected by performing the experiment *in vacuo*, when of course the escape of the hydrogen would be greatly facilitated. The solubility was found under these circumstances to be increased sevenfold. Next the experiment was performed at the boiling temperature of the dilute acid, first when ebullition was prevented by increasing the pressure, and secondly when ebullition was unhindered, thus again facilitating the removal of the hydrogen film. In the first case, when ebullition was prevented, the solubility was practically the same as in the cold; while in the second case, with uninterrupted ebullition, the solubility was increased twenty-four times. Finally, experiments were made to ascertain the effect of introducing into the acid a small quantity of an oxidizing agent capable of converting the hydrogen film to water. When a little chromic acid was thus introduced the solubility was increased 175 times, and when hydrogen peroxide was employed the solubility was increased three-hundred-fold. The explanation of the ease with which the metal becomes attacked when the ordinary impurities are present is that the hydrogen is not then liberated upon the surface of the zinc, but rather upon the more electro-negative impurities, leaving the pure zinc itself open to the continued attack of the acid. The same of course occurs when a plate of platinum is placed in contact with a plate of pure zinc in the acid. The action of nitric acid, the only common acid which does attack pure metals, is evidently due to the oxidation of the hydrogen film by further quantities of the acid, with formation of water and production of the lower oxides of nitrogen, and even under certain circumstances of ammonia.

— The regular quarterly meeting of the Michigan State Board of Health was held at Lansing, July 14. The most important action taken was to direct the secretary to publish a brief pamphlet telling how to restrict and prevent consumption, the pamphlet having been adopted by the board after very careful consideration. This pamphlet states that "consumption is the most common and fatal disease," "that the number of deaths which actually occur in Michigan from consumption is probably over twenty-five hundred per year," that "consumption is now known to be a communicable disease," and that "a large part of this mortality can and ought to be prevented." The pamphlet describes the bacillus which causes consumption and which is in the sputa of consumptives, cites instances where consumption has been communicated by the sputum dust containing these germs, and emphasizes the importance of destroying the sputa of consumptives. The pamphlets on the restriction and prevention of the other most dangerous communicable diseases, diphtheria and scarlet-fever, were ordered reprinted for distribution among the neighbors of those sick with those diseases throughout the State. A proposed pamphlet on the "Restriction and Prevention of Measles" was thoroughly discussed by paragraphs, amended, and the secretary was directed to print and distribute the document for instruction, and as an aid in the restriction and prevention of this disease, which the board declares is a disease "dangerous to the public health," that causes many more deaths in Michingan than small-pox does, and which should be dealt with according to the laws in Michigan.

— In the May number of the *Journal de Botanique*, says *Nature*, MM. Bureau and Franchet describe a number of new plants from the collections recently brought home by M. Bonvalot and Prince Henry of Orleans, and give a general summary of their character, of which the following is an abstract. The collection was made almost entirely in a narrow band of territory reaching from Lhassa eastward near the 30th parallel of north latitude by way of Batang and Sitang to Tatsienlow, in the province of Szechwan, in west China, from which place their route was deflected at a right angle to Yunnan. Considered in its general aspect, the flora of this region, as shown in the collection, is marked by the stunted form of the shrubs and dwarf character of the herbaceous vegetation. Of the forest trees, *Coniferæ* and others, no specimens were brought. It is characteristically a vegetation of high peaks, where drought and strong winds are the main climatic features. The

Papaveraceæ are represented especially by dwarf, large-flowered kinds of *Meconopsis*. The greater number of the species of *Corydalis* are not more than two or three inches high. The *Cruciferæ*, such as *Parrya ciliaris*, in the same way are dwarf and large-flowered. *Silene cæspitosa* may be compared with the most dwarf states of *S. acaulis* of our own high mountains. The honeysuckle of Thibet constitutes only a small bush about a foot high, with intertangled branches. But it is especially in the rhododendrons and primulas that this dwarf character is remarkable. All the rhododendrons and primulas found between Lhassa and Sitang—*R. principis*, *R. primulæflorum*, *R. nigropunctatum*, *Primula leptopoda*, *P. diantha*, and *P. Henrici*—may be ranged amongst the dwarfest types of the genera to which they belong. It is the same with *Incarvillea*. The Thibetan species belong to a group found also in Kansu and central Yunnan, with stem almost obliterated and corolla very large. Passing eastward in Szechwan the flora puts on a different character. The leaves become larger, the number of flowers to each plant increases. There are many *Rosaceæ*, orchids, and species of pedicularis; amongst the *Compositæ* the genus senecio is particularly well represented, and there are several everlastings that approach the edelweiss of the Swiss Alps. The flora of this eastern part of Thibet and western region of Szechwan has a strong affinity both with that of the Sikkim Himalaya and that of central Yunnan. *Meconopsis Henrici* represents the Himalayan *M. simplicifolia* Hook. et Thoms.; *Astragalus litargensis*, *A. acauils* Benth., *Rubus xanthocarpus*, *R. sikkimensis; Brachyactis chinensis*, *B. menthodora; Gnaphalium corymbosum* answers to *G. nubigenum; Androsace bisulca* to *A. microphylla;* and there are many other similar parallels between the plants of Thibet and Sikkim, and in the same many parallels may be found between the new species found by the travellers in Thibet and those gathered by Delavay in Yunnan.

— The numerous letters received at the Wisconsin Agricultural Experiment Station in relation to the chinch bug show that this pest has already done much harm to wheat and barley in some sections of that State, and that it is now moving from the grain fields into the corn fields. Any remedies tried must be quickly applied. It is now too late to introduce infected bugs, such as have been sent out by Professor Snow of Kansas. The kerosene emulsion remedy which is now being successfully used by Dr. E. Fred Russell of Poynette, Columbia County, is recommended. It is made as follows: Slice half a pound of common bar soap; put it in a kettle with one gallon of soft water and boil until dissolved; put two gallons of kerosene in a churn or stone jar, and to it add the boiling hot soap solution; churn from twenty to thirty minutes, when the whole will appear creamy. If properly made no oil will separate out when a few drops of the emulsion are placed on a piece of glass. To each gallon of the emulsion add eight gallons of water and stir. Apply with a sprinkling pot. Every farmer should learn to make this emulsion as it a most useful insecticide. It is especially valuable for killing lice on cattle and hogs. Paris green will not kill chinch bugs. If the bugs are not yet in the corn, plow a deep furrow along the side of the field they will enter and throw into it stalks of green corn. When the bugs have accumulated on the corn, sprinkle with the emulsion. Put in fresh stalks, and sprinkle whenever the bugs accumulate. If they break over the barrier, as they probably will, run a new furrow a few rows back in the corn and repeat. Where they have attacked stalks of standing corn, destroy by sprinkling. If the remedy is tried it should be used persistently. To kill one lot of bugs and then stop will do little or no good. When the bugs threaten to destroy as much as five or ten acres it will pay for one or two men to devote their whole time to the warfare. Only a part of each day, however, will be needed. Some corn will be lost at best, but the most of the field should be saved. Any one trying the remedy is requested to send the results of his experience to the experiment station.

— Professor Martens of Berlin has published in the *Mittheilungen aus den Kœniglichen technischen Versuchanstalten zu Berlin* a report (summarized in *Engineering* of July 17) of some experiments on the strength of steel at various temperatures between 20° C. and 600° C. The material used consisted of mild steel, having a tensile strength of 23 tons, 27 tons, and 30 tons per square inch. The bars from which the test pieces were cut were 1.5 inches in diameter and were thoroughly annealed. A number of bars of the same quality of metal were all tested in the usual way, both after annealing, and as received from the makers, so as to form a standard for the other bars. The temperature of the bars was made uniform by placing in a bath and testing them there. For the low temperature tests the bath was filled with a freezing mixture, and for the high temperature tests, with paraffine, up to 200° C., beyond which alloys of lead and tin were used. The contents of the bath were warmed by gas jets, and stirred during the course of the experiments. The elongations of the bar up to the yield point were taken on a length of 8.1 inches by means of a mirror apparatus, the diameter of the tested portion being 0.79 of an inch, and autographic diagrams were also taken of each specimen. The results of the experiments showed that the elastic limit of the material became lower as the temperature rose, though the falling off was not very serious up to 200° C., but beyond that point it lowers somewhat rapidly, and finally seems to disappear. The maximum stress decreases from 20° C. up to 50° C., but afterwards rapidly rises to a maximum somewhere between 200° and 250° C. Taking the strength of the specimen at 20° C., the maximum stress for the 23-ton steel is 1.34 greater, and the maximum breaking stress is 1.62. For the 27-ton steel the figures are 1.27 and 1.45, and for the 30-ton steel 1.25 and 1.50. The contraction of area for all the specimens was least at about 300° C.

— London *Engineering* announces the formation of a British syndicate, to be known as the Great Lakes Navigation Trading Company, Limited, having a capital of one million sterling with which to establish a fleet of ten steamers, each of 1,500 tons, to establish water communication between Chicago and Great Britain *via* the Great Lakes. The vessels are to be of such dimensions as will enable them to pass through the locks on the Canadian canals, and it is said that they will be ready for starting the service next spring. Keeping in mind the restless activity of Chicago, says the journal named, it is surprising that no regular service of steamers has been started between that port and Britain. There is sufficient traffic. In the Great Lakes there was carried in 1889 nearly 27,500,000 tons of cargo, the fleet of steamers consisting of 2,055 vessels, of 826,000 tons, worth nearly twelve millions sterling. The arrivals and clearances at Chicago have in ten years increased by 72 per cent to 10,250,000 tons, and it is possible to conceive of an equally large increase in the next decade, for 54,411 miles of railway terminate in that city, and in a year work 43,000,000 tons of freight. Besides, in the central northern and north-western groups of States the total tonnage of freight moved is 196,000,000 tons. A fair proportion of this comes to Europe, principally grain; and probably if through sea communication could be established and freight rates reduced, a still larger quantity might be sent. The distance from Chicago to Liverpool by the lakes and *via* New York does not differ much. By the lakes, Welland Canal, and St. Lawrence River, 4,488 miles, and *via* New York by rail, 4,353 miles; so that the latter distance can be covered in 337 hours against 346 hours in the other case. By rail to Montreal and thence by steamer the distance is 4,062 miles, requiring 328 hours. But after all, time is not a material consideration in cargo traffic. The freight rates should decide. Mr. Corthell, in a paper read recently before the Canadian Society of Civil Engineers, strongly advocates the development of this lake trade to England, by the deepening and lengthening of locks and canals, and the construction of ship railways, and he gives figures based on average rates to show that it is probable that freight could be carried by way of the lakes at half the cost of that sent by rail to New York or Montreal, and thence by steamer to Britain. If this be so, then the Chicago people, and particularly Canadians, will do well to study the matter, because to Canada, possibly more than to America, Britain may in the future have to look for grain supplies. The new syndicate wisely lay themselves out for a distinct trade. The vessels are to have extensive refrigerators. To overcome the disadvantage of the season of ice-bound rivers, which continues for rather more than a third of the year, a terminus is to be made at Portland, Maine.

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ELECTRICAL EVAPORATION.[1]

IT is well known that when a vacuum tube is furnished with internal platinum electrodes, the adjacent glass, especially near the negative pole, speedily becomes blackened, owing to the deposition of metallic platinum. The passage of the induction current greatly stimulates the motion of the residual gaseous molecules; those condensed upon and in the immediate neighborhood of the negative pole are shot away at an immense speed in almost straight lines, the speed varying with the degree of exhaustion and with the intensity of the induced current. Platinum being used for the negative pole, not only are the gaseous molecules shot away from the electrode, but the passage of the current so affects the normal molecular motions of the metal as to remove some of the molecules from the sphere of attraction of the mass, causing them to fly off with the stream of gaseous molecules proceeding from the negative pole, and to adhere to any object near it. This property was, I believe, first pointed out by Dr. Wright of Yale College, and some interesting experiments are described by him in the *American Journal of Science and Art* (Third Series, xii. 49, xiv. 169). The process has been much used for the production of small mirrors for physical apparatus.

This electrical volatilization or evaporation is very similar to ordinary evaporation by the agency of heat. Cohesion in solids varies according to physical and chemical constitution; thus every kind of solid matter requires to be raised to a certain temperature before the molecules lose their fixity of position and are rendered liquid, a result which is reached at widely different temperatures. If we consider a liquid at atmospheric pressure,—say, for instance, a basin of water in an open room,—at molecular distances the boundary surface between the liquid and the superincumbent gas will not be a plane, but turbulent like a stormy ocean. The molecules at the surface of the liquid dart to and fro, rebound from their neighbors, and fly off in every direction. Their initial velocity may be either accelerated or retarded, according to the direction of impact. The result of a collision may drive a molecule in such a direction that it remains part and parcel of the liquid; on the other hand, it may be sent upwards without any diminution of speed, and it will then be carried beyond the range of attraction of neighboring molecules, and fly off into and mingle with the superincumbent gas. If a molecule of the liquid has been driven at an angle with a velocity not sufficient to carry it beyond the range of molecular attraction of the liquid, it may still escape, since, in its excursion upwards, a gaseous molecule may strike it in the right direction, and its temporary visit may be converted into permanent residence.

The intrinsic velocity of the molecules is intensified by heat and diminished by cold. If, therefore, we raise the temperature of the water without materially increasing that of the surrounding air, the excursions of the molecules of the liquid are rendered longer and the force of impact greater, and thus the escape of molecules into the upper region of gas is increased, and we say that evaporation is augmented.

If the initial velocities of the liquid molecules can be increased by any other means than by raising the temperature, so that their escape into the gas is rendered more rapid, the result may be called "evaporation" just as well as if heat had been applied.

Hitherto I have spoken of a liquid evaporating into a gas; but the same reasoning applies equally to a solid body. But whilst a solid body like platinum requires an intense heat to enable its upper stratum of molecules to pass beyond the sphere of attraction of the neighboring molecules, experiment shows that a very moderate amount of negative electrification super-adds sufficient energy to enable the upper stratum of metallic molecules to fly beyond the attractive power of the rest of the metal.

If a gaseous medium exists above the liquid or solid, it prevents to some degree the molecules from flying off. Thus both ordinary and electrical evaporation are more rapid in a vacuum than at the ordinary atmospheric pressure.

I have recently made some experiments upon the evaporation of different subjects under the electric stress.

Evaporation of Cadmium. — A U-shaped tube was made, having a bulb in each limb. The platinum poles were at the extremities of each limb, and in each bulb was suspended from a small platinum hook a small lump of cadmium, the metal having been cast on to the wire. The wires were each weighed with and without the cadmium. The tube was exhausted, and the lower half of the tube was inclosed in a metal pot containing paraffine wax, the temperature being kept at 230° C. during the continuance of the experiment. A deposit around the negative pole took place almost immediately, and in five minutes the bulb surrounding it was opaque with deposited metal. The positive pole with its surrounding luminosity could be easily seen the whole time. In thirty minutes the experiment was stopped, and after all was cold the tube was opened and the wires weighed again. The results were as follows:—

	Positive pole.	Negative pole.
Original weight of cadmium	9.34 grains.	9.38 grains.
Weight after experiment	9.25 "	1.86 "
Cadmium volatilized in 30 minutes	0.09 "	7.52 "

Finding that cadmium volatilized so readily under the action of the induction current, a large quantity, about 350 grains, of the pure metal was sealed up in a tube, and the end of the tube containing the metal was heated to a little

[1] Abstract of a paper read by Professor William Crookes, F.R.S., before the Royal Society, London, on June 11; from Nature of July 2.

above the melting-point. The molten metal being made the negative pole, in a few hours the whole quantity had volatilized and condensed in a thick layer on the far end of the tube, near, but not touching, the positive pole.

Volatilization of Silver. — Silver was the next metal experimented upon. The apparatus was similar to that used for the cadmium experiments. Small lumps of pure silver were cast on the ends of platinum wires, and suspended to the inner ends of platinum terminals passing through the glass bulb. The platinum wires were protected by glass, so that only the silver balls were exposed. The whole apparatus was inclosed in a metal box lined with mica, and the temperature was kept as high as the glass would allow without softening. The apparatus was exhausted to a dark space of three millimetres, and the current was kept on for $1\frac{1}{2}$ hours. The weights of silver, before and after the experiment, were as follows: —

	Positive pole.	Negative pole.
Original weight of silver	18.14 grains.	24.63 grains.
Weight after the experiment	18.13 "	24.44 "
Silver volatilized in 1½ hours	0.01 "	0.19 "

In this tube it was not easy to observe the spectrum of the negative pole, owing to the rapid manner in which the deposit obscured the glass. A special tube was therefore devised, of the following character. A silver rod was attached to the platinum pole at one end of the tube, and the aluminum positive pole was at the side. The end of the tube opposite the silver pole was rounded, and the spectroscope was arranged to observe the light of the volatilizing silver "end on." In this way the deposit of silver offered no obstruction to the light, as none was deposited except on the sides of the tube surrounding the silver. At a vacuum giving a dark space of about three millimetres from the silver, a greenish-white glow was seen to surround the metal. This glow gave a very brilliant spectrum. The spark from silver poles in air was brought into the same field of view as the vacuum glow, by means of a right-angled prism attached to the spectroscope, and the two spectra were compared. The two strong green lines of silver were visible in each spectrum. The measurements taken of their wave-lengths were 3,344 and 3,675, numbers which are so close to Thalen's numbers as to leave no doubt that they are silver lines. At a pressure giving a dark space of two millimetres the spectrum was very bright, and consisted chiefly of the two green lines and the red and green hydrogen lines. The intercalation of a Leyden jar into the circuit does not materially increase the brilliancy of the lines, but it brings out the well-known air lines. At this pressure not much silver flies off from the pole. At a higher vacuum the luminosity round the silver pole gets less and the green lines vanish. At an exhaustion of about one-millionth of an atmosphere the luminosity is feeble, the silver pole has exactly the appearance of being red-hot, and the volatilization of the metal proceeds rapidly.

Like the action producing volatilization, the "red heat" is confined to the superficial layers of molecules only. The metal instantly assumes, or loses, the appearance of red heat the moment the current is turned on or off, showing that, if the appearance is really due to a rise in temperature, it does not penetrate much below the surface. The extra activity of the metallic molecules necessary to volatilize them is, in these experiments, confined to the surface only, or the whole mass would evaporate at once, as when a metallic wire is deflagrated by the discharge of a powerful Leyden jar. When this extra activity is produced by artificial heat, one of the effects is the emission of red light; so it is not unreasonable to imagine that when the extra activity is produced by electricity the emission of red light should also accompany the separation of molecules from the mass. In comparison with electricity, heat is a wasteful agent for promoting volatilization, as the whole mass must be raised to the requisite temperature to produce a surface action merely; whereas the action of electrification does not appear to penetrate much below the surface.

If, for the negative electrode, instead of a pure metal such as cadmium or silver, an alloy was used, the different components might be shot off to differen distances, and in this way make an electrical separation — a sort of fractional distillation. A negative terminal was formed of clean brass, and submitted to the electrical discharge *in vacuo*. The deposit obtained was of the color of brass throughout, and on treating the deposit chemically I could detect no separation of its component metals, copper and zinc.

A remarkable alloy of gold and aluminum, of a rich purple color, has been kindly sent me by Professor Roberts-Austen. Gold being very volatile in the vacuum tube, and aluminum almost fixed, this alloy was likely to give different results from those yielded by brass, where both constituents fly off with almost equal readiness. The Au-Al alloy had been cast in a clay tube, in the form of a rod two centimetres long and about two millimetres in diameter. It was sealed in a vacuum tube as the negative pole, an aluminum pole being at the other side. Part of the alloy, where it joined the platinum wire passing through the glass, was closely surrounded with a narrow glass tube. A clean glass plate was supported about three millimetres from the rod of alloy. After good exhaustion the induction current was passed, the alloy being kept negative. Volatilization was very slight, but at the end of half an hour a faint purple deposit was seen both on the glass plate and on the walls of the tube. On removing the rod from the apparatus it was seen that the portion which had been covered by the small glass tube retained its original purple appearance, while the part that had been exposed to electrical action had changed to the dull white color of aluminum. Examined under the microscope, the whitened surface of the Austen alloy was seen to be pitted irregularly, with no trace of crystalline appearance.

This experiment shows that, from an alloy of gold and aluminum, the gold is the first to volatilize under electrical influence, the aluminum being left behind. The purple color of the deposit on glass is probably due to finely-divided metallic gold. The first deposit from a negative pole of pure gold is pink; this changes to purple as the thickness increases. The purple then turns to green, which gets darker and darker until the metallic lustre of polished gold appears.

If we take several liquids of different boiling-points, put them under the same pressure, and apply the same amount of heat to each, the quantity passing from the liquid to the gaseous state will differ widely in each case.

It was interesting to try a parallel experiment with metals, to find their comparative volatility under the same conditions of temperature, pressure, and electrical influence. It was necessary to fix upon one metal as a standard of comparison, and for this purpose I selected gold, its electrical volatility being great, and it being easy to prepare in a pure state.

An apparatus was made that was practically a vacuum tube with four negative poles at one end and one positive pole at the other. By a revolving commutator I was able to make electrical connection with each of the four negative poles in succession for exactly the same length of time (about six seconds); by this means the variations in the strength of the current, the experiment lasting some hours, affected each metal alike.

The exposed surface of the various metals used as negative poles was kept uniform by taking them in the form of wires that had all been drawn through the same standard hole in the drawplate, and cutting them by gauge to a uniform length; the actual size used was 0.8 of a millimeter in diameter and twenty millimetres long.

The comparison metal, gold, had to be used in each experiment; the apparatus thus enabled me to compare three different metals each time. The length of time that the current was kept on the revolving commutator in each experiment was eight hours, making two hours of electrification for each of the four negative electrodes; the pressure was such as to give a dark space of six millimetres.

The fusible metals, tin, cadmium, and lead, when put into the apparatus in the form of wires, very quickly melted. To avoid this difficulty a special form of pole was devised. Some small circular porcelain basins were made, nine millimetres in diameter; through a small hole in the bottom a short length of iron wire, 0.8 of a millimetre in diameter, was passed, projecting downwards about five millimetres; the basin was then filled to the brim with the metal to be tested, and was fitted into the apparatus exactly in the same way as the wires. The internal diameter of the basin at the brim was seven millimetres, and the negative metal filed flat was thus formed of a circular disk seven millimetres in diameter. The standard gold pole being treated in the same way, the numbers obtained for the fusible metals can be compared with gold, and take their place in the table.

The following table of the comparative volatilities was in this way obtained, taking gold as 100: —

Palladium	108.00	Platinum	44.00
Gold	100.00	Copper	40.24
Silver	82.68	Cadmium	31.99
Lead	75.04	Nickel	10.99
Tin	56.96	Iridium	10.49
Brass	51.58	Iron	5.50

In this experiment equal surfaces of each metal were exposed to the current. By dividing the numbers so obtained by the specific gravity of the metal, the following order is found: —

Palladium	9.00	Copper	2.52
Silver	7.88	Platinum	2.02
Tin	7.76	Nickel	1.29
Lead	6.61	Iron	0.71
Gold	5.18	Iridium	0.47
Cadmium	3.72		

Aluminum and magnesium appear to be practically non-volatile under these circumstances.

The order of metals in the table shows at once that the electrical volatility in the solid state does not correspond with the order of melting-points, of atomic weights, or of any other well-known constant. The experiment with some of the typical metals was repeated, and the numbers obtained did not vary materially from those given above, showing that the order is not likely to be far wrong.

It is seen in the above table that the electrical volatility of silver is high, while that of cadmium is low. In the two earlier experiments, where cadmium and silver were taken, the cadmium negative electrode in thirty minutes lost 7.52 grains, whist the silver negative electrode in $1\frac{1}{2}$ hours only lost 0.19 of a grain. This apparent discrepancy is easily explained by the fact (already noted in the case of cadmium) that the maximum evaporation effect, due to electrical disturbance, takes place when the metal is at or near the point of liquefaction. If it were possible to form a negative pole *in vacuo* of molten silver, then the quantity volatilized in a given time would be probably more than that of cadmium.

Gold having proved to be readily volatile under the electric current, an experiment was tried with a view to producing a larger quantity of the volatilized metal. A tube was made having at one end a negative pole composed of a weighed brush of fine wires of pure gold, and an aluminum pole at the other end.

The tube was exhausted and the current from the induction coil put on, making the gold brush negative. The resistance of the tube was found to increase considerably as the walls became coated with metal, so much so that, to enable the current to pass through, air had to be let in after a while, depressing the gauge one-half of a millimetre.

The weight of the brush before experiment was 35.494 grains. The induction current was kept on the tube for $14\frac{1}{2}$ hours; at the end of this time the tube was opened and the brush removed. It now weighed 32.5613 grains, showing a loss of 2.9327 grains. When heated below redness the deposited film of gold was easily removed from the walls of the tube in the form of very brilliant foil.

After having been subjected to electrical volatilization, the appearance of the residual piece of gold under the microscope, using a quarter-inch object-glass, was very like that of electrolytically deposited metal, pitted all over with minute hollows.

This experiment on the volatilization of gold having produced good coherent films of that metal, a similar experiment was tried, using a brush of platinum as a negative electrode. On referring to the table it will be seen that the electric volatility of platinum is much lower than that of gold, but it was thought that by taking longer time a sufficient quantity might be volatilized to enable it to be removed from the tube.

The vacuum tube was exhausted to such a point as to give a dark space of six millimetres, and it was found, as in the case of gold, that as a coating of metal was deposited upon the glass the resistance rapidly increased, but in a much more marked degree, the residual gas in the tube apparently becoming absorbed as the deposition proceeded. It was necessary to let a little air into the tube about every thirty minutes, to reduce the vacuum. This appears to show that the platinum was being deposited in a porous spongy form, with great power of occluding the residual gas.

Heating the tube when it had become this way non-conducting liberated sufficient gas to depress the gauge of the pump one millimetre, and to reduce the vacuum so as to give a dark space of about three millimetres. This gas was not re-absorbed on cooling, but on passing the current for ten minutes the tube again refused to conduct, owing to absorption. The tube was again heated, with another liberation of gas, but much less than before, and this time the whole was re-absorbed on cooling.

The current was kept on this tube for twenty-five hours; it was then opened, but I could not remove the deposited metal except in small pieces, as it was brittle and porous. Weighing the brush that had formed, the negative pole gave the following results: —

	Grains.
Weight of platinum before experiment	10.1940
" " after experiment	8.1570
Loss of volatilization in 25 hours	2 0370

Another experiment was made similar to that with gold and platinum, but using silver as the negative pole, the pure metal being formed into a brush of fine wires. Less gas was occluded during the progress of this experiment than in the case of platinum. The silver behaved the same as gold, the metal deposited freely, and the vacuum was easily kept at a dark space of six millimetres by the very occasional admission of a trace of air. In twenty hours nearly three grains of silver were volatilized. The deposit of silver was detached without difficulty from the glass in the form of bright foil.

THE METEOROLOGICAL RESULTS OF THE "CHALLENGER" EXPEDITION.[1]

SEEING that water covers nearly three-fourths of the surface of the globe, and exercises an important influence on the temperature of the air above it, and, by the intervention of winds, extends that influence over the land surfaces, it was impossible to give a satisfactory account of the meteorology of the earth in the absence of records of a complete series of observations taken in the open ocean. It was, therefore, of the utmost importance that the records of the "Challenger" expedition should be thoroughly digested, and this work Dr. Buchan, after seven years' labor, brought to a conclusion rather more than a year ago. In addition to the results of the "Challenger" observations, he also made use of records of temperature, atmospheric pressure, etc., received from a large number of stations in all parts of the world. Some of the most striking points in the report are given in an address to the Royal Geographical Society, published in the Proceedings for March and accompanied by four maps, of which two show the distribution of temperature and atmospheric pressure, respectively, for the month of January, and the other two the same phenomena for July. These are reproductions of some of the fifty-two maps annexed to the report.

One important fact that the "Challenger" observations revealed is, that the daily variation of the temperature on the surface of the ocean away from land is very small, nowhere exceeding a degree between latitudes 40° north and 40° south, and falling to one-fifth of a degree in the high latitudes. The temperature of the air was found to have a range about three to four times as great as that of the water below. In the Southern Ocean, at latitude 63°, it was 0.8 of a degree, or four times as great as that of the sea in the same region. Over the open sea the humidity curve closely follows that of the temperature, falling to a minimum at four o'clock in the morning and rising to a maximum at two in the afternoon; but near land a second minimum occurs from about 10 A.M. to 2 P.M. At this time, the land being heated, a current rushes in from the sea to take the place of the hot air that rises from it, and dry air from the upper regions of the atmosphere descends over the ocean. Over the open sea the barometer, though removed from the disturbing influence of land, shows as marked oscillations as over land where the diurnal variation of temperature is great. The cause must be sought in the daily changes in the temperature and humidity of the air produced through all its height by solar and terrestrial radiation.

Another important fact is that, latitude for latitude, the amplitude of the barometric oscillations is larger in an atmosphere highly charged with aqueous vapor than in a dry one. In the anticyclonic regions of the Atlantic and Pacific, the barometer falls only about 0.025 inches from the morning maximum to the afternoon minimum. Since pressure remains high, though currents of air are constantly flowing out from these regions in all directions over the surface of the ocean, it follows that the dry air from above must descend into their centres. These anticyclonic regions play a most important part in regulating the climates of the neighboring continents. The four principal lie in the Atlantic and Pacific, at about latitudes 36° north and south, and appear in all the monthly charts, with the exception of the North Atlantic region, which is absent in the month of January only. The absolutely highest mean pressure for any month, about 30.5 inches, is to be found in central Asia in the month of January. Here, to the south of Lake Baikal, is the centre of a great anticyclone, covering a large part of Eurasia, from which south and south-west winds blow over Russia and western Siberia, raising the temperature of these countries. Their effect may be seen on the temperature chart, on which the isothermals run nearly north and south.

[1] From the Scottish Geographical Magazine for July.

Another example of the effect of pressure on climate may be taken from the low-pressure system in the North Atlantic, where the lowest mean pressure of 29.5 inches occurs between Iceland and the south of Greenland. This system gives rise in winter to south-westerly winds in western Europe, and north-westerly winds over North America. While, therefore, the temperature of the former is abnormally raised by winds from lower latitudes, that of the latter is lowered by cold breezes from the Arctic regions. Hence, the temperature of the coast of Labrador is only — 13°, while on the same parallel in Mid-Atlantic it is 45°, or 58° higher.

The influence of other cyclonic and anticyclonic areas is discussed in Dr. Buchan's article. In reference to the drawing of isobars, the author gives a warning against the use of observations in steep and confined valleys, where descending cold currents at night and ascending warm currents in the afternoon unduly raise and depress the barometer alternately. Thus, in the Valley of Tönset, in Norway, the mean is 29.95 inches, while at Dovrê, situated at about the same elevation but separated from Tönset by a broad range of mountains, it is 29,87 inches.

Lastly, a few figures must be quoted regarding the velocity of the wind. This the "Challenger" observations showed to be greater over the open sea than near land, the mean difference being from four to five miles per hour. It is greatest over the Southern Ocean (23 miles per hour) and least over the North Pacific (15 miles). The curves on the open sea show a very slight diurnal variation, but near land they exhibit a distinct minimum between 2 and 4 A.M., and a maximum from noon to 4 P.M. The difference between the velocities on sea and land is greatest at 4 A.M., and gradually falls to a minimum at 2 P.M., demonstrating the effect of the land in reducing the velocity by friction, and the fact that this effect is, in some way or other, partially counteracted by the heating of the surface of the land. Such are a few of the important results pointed out in Dr. Buchan's paper, which is so full of valuable information that no abstract can do it justice.

THE NEW LAKE IN THE COLORADO DESERT.

SPEAKING of the lake recently formed in the Colorado desert, in the southern part of California, by the overflow of the Colorado River, Major J. W. Powell, director of the United States Geological Survey, recently gave a reporter of the New York *Times* some interesting facts.

"The traditions of the Indians are by no means the only evidence that this basin has been filled, wholly or partially, before," said Major Powell. "Since the delta was formed, and that portion of the Gulf of California was cut off and left to evaporate under the terrific heat of the sun, the Colorado has been playing pranks of this sort on several occasions. Along the hills which form the sides of this basin there are shoremarks which indicate that at different times the basin has been flooded to different heights, and then, when the river cut back through its old channel, evaporatian has again changed the lake to a parched desert. Along these shore-lines shells have been found which confirm this theory. The action of the Colorado in cutting new mouths for itself and then stopping them up is comparatively rapid because of the quantity of silt which the stream carries. It is not unlikely that the supposed traditions of the Indians are facts within the memory of some of the older ones of the scattering bands that live on the hillsides along the basin, for indications are that the valley has been inundated within fifty years, and certainly it has been at least once or twice since this continent was discovered.

"There is no immediate danger of the basin being filled, because it requires a large volume of water to fill it to the river level, and the evaporation is something wonderful. At the present time, according to reports, only a fraction of the water in the Colorado is flowing through this new outlet. It is possible that the channel may be enlarged as the stream continues to flow through it, so that all the water in the river will pour into the basin. Even if that were to happen the evaporation is great enough to take up fully one-half of the Colorado as it spreads over the basin, and it would probably require from two to three years for the balance to fill the hole up to level. At such times as the river filled the basin to its level the flow to the Gulf of California has been through a channel which begins at the lower end of the basin, and makes a short cut directly south to the salt water. This is called Hardy's Colorado, and it is usually simply a dry channel or ditch. It may have been formed under circumstances similar to those existing at present. It is large enough to accommodate the entire volume of the Colorado after the evaporation which is sure to take place while the water is spread over the basin.

"Some idea of the terrible heat may be had from the evaporation which takes place. If the basin were filled to the river level, the lake would present a surface of about 1,600 square miles. This would be lowered at the rate of six feet a year by evaporation. The salt which is now being mined at Salton was deposited in the valley by the previous evaporations. The original salt deposit from the water which was a part of the Gulf of California is not responsible for all that is found there. The waters of the Colorado are saline, for the river flows through beds of rock salt at places many miles up from its mouth, and the successive deposits from the waters of this river as they have flooded the valley and then dried up have added largely to the original deposit."

OXFORD SUMMER MEETING OF UNIVERSITY EXTENSION STUDENTS.[1]

THE process by which university extension is carried throughout the country and made a vehicle for the further education of the adult student is well known, and is gradually becoming more and more appreciated in proportion as those who are responsible for the method improve the lines on which it is carried out. The machinery employed embraces lectures, classes, travelling libraries, etc., but one element vitally necessary to the university student is not supplied by these aids. This element is that of residence, and it was a happy suggestion on the part of the originators to propose that, for one month in the long vacation, arrangements should be made by which those who have profited by being brought into contact with a university lecture should enjoy the additional advantage of being brought under the charm that haunts the colleges and cloisters of Oxford and Cambridge.

The Oxford summer meeting commences on July 31, and is continued throughout the month of August; but, for the benefit of students who are unable to be present during so long a period, the course is divided into two sections, the second commencing on August 12. It has been found desirable to remove as far as possible the fragmentary and isolated character of the lectures given at these meetings, and therefore, while the course will be complete and independent in itself, it will also form the first part of a cycle of study which for its full development will embrace a period of four summers.

That these lectures propose something more than to add piquancy to an agreeable picnic will be shown from the following slight sketch of the subjects treated — and treated by authorities of acknowledged reputation. To take the lectures on natural science first: in physiology, Mr. Poulton will discuss the recent criticisms of Weismann's theory of heredity, and Mr. Gotch will lecture on the functions of the heart. In chemistry, Professor Odling lectures on the benzine ring, and under the supervision of Mr. Marsh a course of practical chemistry will be conducted in the laboratory of the University Museum. In geology, a course of practical instruction will be given by Professor Green and Mr. Badger, to include excursions in the neighborhood of Oxford. A class in practical astronomy will be welcomed at the university observatory; while electricity finds an able exponent in Mr. G. J. Burch. But the distinguishing feature of this meeting is the attention given to agricultural science "designed for agricultural audiences under county council schemes." This designation seems somewhat vague, and it will be very interesting to see the character of the audience attracted by this title. Four lectures are offered: the first entitled, "The Application of Science to the Art of Agriculture." This description is sufficiently wide, but does not indicate whether the lecture is intended as a sample of those which state-aided board schools in agricultural districts might well offer to lads who have passed through the successive standards, or as one addressed to the sons of farmers, and supplying that form of instruction which it is the duty of agricultural colleges to impart. Another lecture is offered on the management of poultry. This is more definite and more hopeful; and when we remember that the students who come up for these summer meetings are, for the most part, ladies, who can well be supposed to take an intelligent interest in this part of farming operations, we must admit that the subject is well chosen. Manures of various characters form the subject of the other two lectures, and will be doubtless of a sufficiently technical character.

The literature and history lectures are of special interest, and by the combination of many lecturers are made to cover with great completeness the mediæval period. Mr. Frederic Harrison gives, as an inaugural lecture, a survey of the thirteenth century, and strikes the keynote of this section: while in the entire course, which embraces some sixty lectures, we meet the names of Professor Dicey, of Mr. York Powell, of Mr. Boas, and a host of others, affording alike a sufficient guarantee for the excellence of the work, and a happy augury for the success of the meeting.

[1] Nature, July 16.

THE FORESTS OF ZULULAND.

AN interesting and valuable report on the forests of Zululand, by Colonel Cardew, has been issued by the British Colonial Office as an official paper. Colonel Cardew's report, an abstract of which we find in the Proceedings of the Royal Geographical Society for July, deals in the first place with the existing state of the forests of Zululand, then with the measures necessary to preserve them, and lastly with the establishment of a staff necessary for the enforcement of the laws and regulations required to effect the better preservation of these forests. As to their general distribution, the forests of Zululand, Colonel Cardew says, may be conveniently divided in the same manner as has been done by Mr. Fourcade, assistant conservator of forests, in his report on the Natal forests; that is to say, into high timber forests, thorn bush, and coast forests. The high timber forests are situated on the Nkandhla and Qudeni ranges of mountains in the Nkandhla district; on the Entumeni and Eshowe Hills and the Ungoye Mountains, in the Eshowe district; on the slopes of the Ceza, and on the Useme, Empembeni, Makowe, and other hills in the Ndwandwe district; and on the VBombo Mountains, in the district of that name. The thorn bush is to be found to a greater or less extent in all the river valleys of Zululand, the timber increasing in size and the bush in density on the lower parts of the rivers, especially in those of the Umkusi, and White and Black Umfolosi. It is very large and dense in the country west of St. Lucia Lake.

The coast forests are of no great extent, with the exception of the Dukuduku; they grow in small patches along the streams and rivers near the coast, and especially at their mouths, and also cover the low sand-hills which border the coasts of Zululand. The Dukuduku is situated on the north side of the lower Umfolosi River in the district of that name. It is several miles in extent and very dense, and was the place of retreat of the coast chiefs during the disturbances of 1888. Dealing more particularly with the distribution of the high timber forests, Colonel Cordew states that the Qudeni forests clothe the slopes and spurs of the Qudeni Mountain, a magnificent range rising to an altitude of some 4,500 to 5,000 feet, and situated between the Tugela and Insuzi Rivers. The forests are of great extent. In the absence of a survey it is impossible to say what area they cover, but they clothe the southern, eastern, and northern slopes of the mountain, and from their extent and vastness are most imposing in appearance. They are certainly the finest forests in Zululand, and are composed of the most valuable timber, of the same nature and variety as that of the high timber forests of Natal. Yellow wood, both onteniqua and upright, abounds, and there is also every description of hard wood, but from want of adequate protection these noble forests have in many parts been ruthlessly destroyed. Woodcutters do their work in the most reckless and wasteful fashion, and are subject to no sort of efficient control.

The district of Nkandhla comprises the long range of mountainous country which forms the watershed between the Umhlatuze and Insuzi rivers. The highest ridge, which attains an altitude of at least 4,500 feet, is called Nomance. The Nkandhla forests are of great extent, and are situated chiefly on the southern slopes of the Nkandhla range. One belt of forest, called the Dukuza, is several miles in length, and takes two hours to traverse on horseback. Many are of opinion that these forests are finer than those of the Qudeni. They have not suffered at all from the spoilers in the shape of sawyers, but licensed pole-cutting has been going on to some extent on the Nomance ridge. This pole-cutting is very destructive to forests unless the work is carefully supervised by a forest department, and the poles to be cut selected with a view to proper cultural treatment, which has not been the case.

The Entumeni forests are situated on the highlands, which rise to an altitude of 2,800 feet, between the Mhlatuzi and Matikulu rivers. The timber in these forests is inferior to that of the Qudeni and Nkandhla. The Eshowe forests are not very extensive; they grow in patches on sheltered kloofs and hollows, and along water-courses and streams, filling up the valleys. They are most abundant on the eastern and southern slopes of the Eshowe range. They furnish no hard woods of any value.

Next to the Qudeni and Nkandhla, the Ingoye forest is the finest in Zululand. It is situated along and on the southern slopes of the Ingoye range, which forms the watershed between the Mhlatuzana and Mlalazi rivers. It grows at an altitude of from 1,000 to 1,500 feet, and is of great length, extending from ten to twelve miles. It is a virgin forest in the sense that it has never been cut into by sawyers, but the work of denudation by the natives is very apparent, more so than elsewhere. It is evident from the stumps of trees left, and from patches of wood here and there, that the lower slopes of the Ingoye range were formerly clothed with forests to its base, but gradually by the process of cultivation and wattle cutting the forest line is receding up the mountain. Other patches of forest land are scattered here and there throughout Zululand, but these are the most important forests which call most urgently for some regulation, lest by the joint action of whites and natives they should be to a great extent deteriorated or even destroyed.

BOOK-REVIEWS.

Education and Heredity. By J. M. GUYAN. Tr. by W. J. Greenstreet. (Contemporary Science Series.) New York, Scribner. 12°. $1.25.

THE title of this book is misleading, there being nothing in it about the relations of education to hereditary tendencies except a brief passage at the end of the second chapter. A large part of the book is devoted to a presentation of the author's peculiar theory of the origin of the moral sentiments, a theory which he evidently deemed of great value, but which seems to us about as worthless as a psychological theory well can be. M. Guyan affirms that the mere power of doing right leads us to do right, or, as he expresses it, "to be inwardly aware that one is capable of doing something greater is *ipso facto* to have the dawning consciousness that it is one's *duty* to do it" (p. 72). Evidently M. Guyan was not much gifted with the philosophical faculty. When, however, he leaves these discussions about the origin of the moral faculty and turns to his proper subject of education, he says many things that are wise and suggestive, though nothing that is really original.

His first point is the importance of moral education, on which he dwells at considerable length, maintaining, in opposition to Ribot and others, that precept and example have a powerful influence on the moral nature, modifying in a marked degree the inborn tendencies of the individual. Physical education, too, is dwelt upon at considerable length, the author fearing the effect of over-study upon the young and especially upon girls. When he comes to treat of intellectual education he takes somewhat different ground from what his scientific proclivities would lead us to expect, putting science in a secondary place, and assigning the first to the humanities. "We ought," he says, "to place esthetic before intellectual and scientific instruction, because the beautiful lies nearest to the good, and esthetics, art, literature, and what have been so well called the humanities, are the least indirect influences making for morality" (p. 161). The book as a whole, barring the author's strange theory of the moral sense, is a good one, and will doubtless be interesting to educators.

AMONG THE PUBLISHERS.

THE *Illustrated American* for Aug. 1 contains a good portrait of the late Edward Burgess.

—Charles L. Webster & Co. have now ready Mrs. Alexander Ireland's "Life of Jane Welsh Carlyle."

— G. P. Putnam's Sons have just ready in the Story of the Nations series "The Story of Portugal," by H. Morse Stevens.

— The Seegur & Guernsey Co., 7 Bowling Green, New York, will publish at once the "Cyclopædia of the Manufactures and Products of the United States" in a revised and enlarged form.

— In *Outing* for August is an article on "Photographing in the White Mountains," by Ellerslie Wallace, and one on the "Theory and Introduction of Curve Pitching," by O. P. Caylor.

— Howard Lockwood & Co. have just issued Part 2 of their "American Dictionary of Printing and Bookmaking" It extends from Blatt to Chinese Printing, and is, like its predecessor, freely illustrated with technical cuts and with portraits.

— In its August number the *New England Magazine* publishes the "Harvard Commencement Essays." The topics are, "The Harvard Senior," by Henry R. Gledhill; "Edward Rowland Sill," by Charles W. Willard; and "A Remedy for American Philistinism," by Charles Lewis Slattery.

— The August *Babyhood* contains an article on hay-fever by Dr. Samuel Ashhurst, who lays great stress on the importance of counteracting the tendency towards hay-fever in childhood. "Science for Children," in the same number, is an article that contains information as to how to make out-door life at the present season profitable to both mother and child.

— In the *Atlantic Monthly* for August, Olive Thorne Miller, in "Two Little Drummers," treats the yellow-bellied woodpecker (sometimes called the sap-sucker) and the red-headed woodpecker; and Agnes Repplier contributes a paper on "The Oppression of Notes," which will touch a responsive chord in readers who have struggled with foot-notes far too copious and obtrusive.

— "The Press as a News Gatherer" is the subject of a paper by William Henry Smith, manager of the Associated Press, in the August *Century*, and is the first of several separate papers on journalism which are to appear in that periodical. Mr. Smith traces the origin and growth of the Associated Press, and discusses topics of special interest to newspaper editors, as well as to the public.

— John Wiley & Sons are engaged upon the work of getting out Thurston's "Manual of the Steam Engine." The first volume is printed, and will soon appear; the second is in press. The work makes two volumes of about 850 pages each, and is intended for use by engineers generally, as well as by students in the graduated courses directed by its author in Sibley College at Cornell University, and for other technical schools giving attention to such advanced work. Part I. is devoted to the development, structure, and theory of the engine; Part II. to the design, construction, and operation, and to the finance of its application. Part II. also includes a chapter on engine-trials, with special attention to experimental research and the scientific study of the engine. Messrs. Baudry & Cie of Paris have applied for and received the contract for publication of a translation into French, to be issued next year. They have already in hand, and well advanced, a translation of Thurston's "Engine and Boiler Trials," published in America and Great Britain by the Wileys, and which has already passed to a second edition. It is anticipated that the

"Manual" will find a very large sale both in the United States and Europe.

— An American edition of the Rev. J. B. Lock's "Arithmetic for Schools," edited and arranged by Charlotte A. Scott of Bryn Mawr College, has been issued by Macmillan & Co. In this work Mr. Lock has aimed to avoid novelty in method or in arrangement, though it differs in some respects from other works on the same subject. Rules, for instance, are to a great extent entirely omitted, specimen examples fully worked out being given instead, the theory, concisely stated, being set forth in large type, and the illustrations and explanations in smaller type. The examples are numerous and well graded.

— The August *Magazine of American History* is a rich midsummer number. It opens with the first part of an article on "The Spartans of Paris," by General Meredith Read, illustrated with portraits of literary celebrities of France. A picture of the editor and author, M. Arsène Houssaye, forms the frontispiece to the number. "The Fifteenth State," by John L. Heaton, gives information in relation to the settlement of Kentucky, showing how the mountain barriers were passed, and that a race-course was established in 1775, so early that one man was shot by Indians while speeding his horse upon it. "The Beginnings of the City of St. Joseph," by Judge William A. Wood, is an account of the founding of that city less than half a century ago. It contains an amusing picture of the first post-office there, in 1841, which was an old hat. The fourth paper of the number, entitled "The Right Reverend Samuel Provoost, first Bishop of New York," by Rev. Isaac S. Hartley, is a study, not only of the varied work of the subject, but of the exciting times in which he lived. "A Character Sketch of Mr. Gladstone," by Hon. J. L. M. Curry, will attract every reader. A paper follows on "Governor Meriwether Lewis," the explorer of the western part of the continent, contributed by General Marcus J. Wright of Washington. Other articles include "The Bewitched Children of Salem, 1692," by Caroline E. Upham; "The Royal Couple of Roumania;" "Archæology in Missouri," by O. W. Collett; and "The Four New York or Senior Regiments of Troops in 1775."

— "Lessons in Astronomy," by Professor Charles A. Young (Boston, Ginn & Co.), has been prepared to meet the wants of certain classes of schools which find the same author's "Elements in Astronomy" too extended and mathematical to suit their course and pupils. It is based upon the last-named work, but with many condensations, simplifications, and changes of arrangement. One of the principal changes is the placing of the uranography, or "constellation-tracing," in the body of the text, near the beginning, and supplementing it with brief notes on the mythology of the constellations.

— Ginn & Co. have in press the first volume of Bacon's "Advancement of Learning," edited by Prof. A. S. Cook of Yale. In this edition the quotations from the ancient tongues are all relegated to the foot of the page, and their place in the text is supplied by as adequate a translation as possible. In this way the needs of the average student and those of the person of special erudition are both provided for; the former experiences no interruption, and the latter may read the exact words which Bacon wrote. The same principle is adopted in the notes. Many of the latter are not original with the present editor, but they are such as any one who understands English may read.

— The American Book Company have just issued "Elements of Civil Government," by Alexander L. Peterman. It is a small book, intended for the use of schools, and as it attempts to deal with the whole subject of American government, federal, State, and municipal, the treatment is necessarily brief and somewhat superficial. The descriptive portions, however, are quite good, and the work is not encumbered, as so many such books are, with a mass of irrelevant historical matter. It opens with an account of government in the family and in the school, which can hardly be called civil government, and then proceeds to treat successively of the town, county, city, and State, and of the United States. To our mind this is a wrong method of procedure, the State being the foundation of civil order, and therefore requiring to be treated first; while the towns and counties, being mere agents of the State, should be passed over with slight notice. Mr. Peterman fails, too, as most writers of such treatises do, to give a clear idea of what government is for, and why we are bound to obey it. The work is faulty also in reviving the old fiction of a social contract as the basis of civil society; and in general the theoretical parts of the book are inferior to the descriptive. It will serve, however as an introduction to the subject, which can afterwards be pursued in more philosophical treatises.

— D. C. Jackson, electrical engineer in charge of the central district of the Edison General Electric Company, with headquarters at Chicago, has accepted the chair of electrical engineering in the University of Wisconsin.

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SCIENCE

NEW YORK, AUGUST 7, 1891.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

By invitation of the several scientific associations in Washington, the fortieth meeting of the American Association for the Advancement of Science will be held in the city of Washington, beginning with the council meeting on Monday, Aug. 17. As there will be meetings of several affiliated societies about the time of the association meeting, and as the International Congress of Geologists will hold its first meeting in this country during the last week in August, the official time given for the association meeting will be from Aug. 17 to Sept. 2. This will allow members of the association to unite with and attend the meetings of the other societies.

The hotel headquarters of the association will be the Arlington, near the buildings of Columbian University (corner of 15th and H Streets, N.W.), in which will be the offices, the hall for general sessions, and the rooms for the several sections.

For information relating to membership and papers, address F. W. Putnam, Permanent Secretary, Salem, Mass. For all matters relating to local arrangements, hotels, railway rates, and certificates, address Mr. Marcus Baker, Local Secretary, United States Geological Survey, Washington.

Abstracts of papers, and nominations of members and fellows, should be mailed to the Permanent Secretary, Salem, Mass., until Aug. 10: after that date his address will be the Arlington, Washington.

All botanists, members of the association, are requested to register at Room 22 as soon as practicable after their arrival. The ordinary meetings of the Botanical Club of the association will be held in Room 22, on Thursday, Friday, and Saturday, at 9 o'clock A.M. Mr. Wm. M. Canby, Wilmington, Del., president; Mr. B. T. Galloway, Washington, D.C., secretary.

The Entomological Club will meet daily at 9 A.M., in Room 15. All entomologists, members of the association, are requested to register in Room 15, as soon as possible after their arrival. Professor Herbert Osborn, Ames, Iowa, president; Dr. C. M. Weed, Hanover, N. H., secretary.

The American Microscopical Society will meet on Aug. 11 and 12.

The Association of American Agricultural Colleges and Experiment Stations will meet in the Law Lecture Room of Columbian University on Wednesday, Aug. 12, at 10 A.M., and will have daily sessions on Aug. 13, 14, 15. Under the terms of the new trust, which endows in perpertuity the great agricultural work of Lawes and Gilbert at Rothamsted, England, a representative of Rothamsted is to visit America every three years as an exponent of Rothamsted and its work. The first of these visits is to occur at the Washington meeting, and R. Warrington, F.C.S., the chemist at Rothamsted, has been appointed representative. He will give six evening lectures, beginning on Aug. 12.

The Association of Official Agricultural Chemists will meet in the Law Lecture Room of the Columbian University, on Thursday, Aug. 13, at 10 A.M., and continue its sessions Friday and Saturday.

The meetings of the Society for the Promotion of Agricultural Science will be held on Monday and Tuesday, Aug. 17 and 18, in the Columbian University. A conference of chemists, including a meeting of the Washington Chemical Society, will be held Aug. 17 or 18 at the same place; and the Association of Economic Entomologists will meet on Aug. 18 and 19.

The Geological Society of America will hold its summer meeting on Monday and Tuesday, Aug. 23 and 24, in Columbian University. Mr. Baily Willis, United States Geological Survey, is chairman of the local committee of arrangements for the society, and Professor H. L. Fairchild of Rochester, N.Y., is secretary of the society. These gentlemen will give further information on application.

The International Congress of Geologists will begin its meeting at 10 o'clock on Wednesday, Aug. 25, in the Columbian University, and will continue with daily sessions until Tuesday, Sept. 1. On Wednesday, Aug. 26, a reception will be given to the International Congress by the Geological Society of America.

For further information relating to the congress, address Mr. S. F. Emmons, United States Geological Survey, Secretary of Committee of Organization.

The capital contains so many public buildings and institutions of interest to strangers that it is proposed to pay special attention to arrangements by which members of the association and their friends can utilize to the best advantage the intervals between meetings, receptions, and other engagements that must necessarily occupy much of their time. Through the co-operation of the heads of the various departments and bureaus, suitable times will be assigned, and officers detailed, to facilitate visits to the Capitol, White House, department buildings, scientific bureaus, Smithsonian Institution, National Museum, Washington Monument, Navy Yard, Naval Observatory, and other places of interest within easy driving distance, such as the National Zoological Park, Soldiers' Home, Arlington, and Glen Echo.

Excursions may be made to Alexandria, Mt. Vernon, Bay Ridge, Great Falls of the Potomac, Harper's Ferry, Luray Cavern, the Grottoes of the Shenandoah, Natural Bridge, Penmar, Gettysburg, and Old Point Comfort. Details regarding these and similar excursions will be arranged, and the most favorable terms secured, in order that members may come to an early decision as to the trips they desire to make.

In addition to excursions such as those mentioned, it has been suggested that some members of the association might like to make a short ocean voyage after the meeting, such as, for instance, to the West Indies, the Bahamas, Bermuda, or Newfoundland. The round trip from New York to St. Johns, N.F., *via* Halifax, can be made in twelve days; or, if extended to Pilley Island (in latitude 49° 34′ north, longitude 55° 50′ west), in eighteen days. For a party of forty persons the individual expense for the round trip to St.

Johns would be $50, and to Pilley Island $60. Similarly, very favorable terms can be obtained for other voyages, and the committee will be pleased to render all the assistance in its power in arranging the details of such excursions.

A reception to the association will be given by the Board of Trade of Washington in the parlors of the Arlington at the close of the president's address on Wednesday evening, Aug. 19.

THE CURABILITY OF PULMONARY PHTHISIS.

IN reference to the question of the curability of consumption, says Dr. T. Harris in the *Lancet* of May 2, we may recognize three classes of cases.

1. Cases of very limited tubercular disease of the lung, where the lesion is small, and is eventually replaced either by fibrous tissue and a completely calcified caseous focus. As far as our experience goes, such cases are always instances of very localized and very small foci, and the disease is never an extensive one. These cases are the only ones which can be considered as perfectly healed, and where the lesion (cicatrix or calcareous focus) which remains does not involve a risk to the possessor, such lesions, so far as we know, not being liable to set up either a local or general tuberculosis. These lesions are not unfrequently found in the lungs of persons who have died of various diseases and from injuries, but it is not known how frequently the tubercular change has been extensive enough to cause distinctive signs and symptoms of pulmonary tuberculosis. Probably the majority of the persons in whose bodies such foci of obsolete tubercle are found have at no period of their lives presented the usual signs or symptoms of consumption, the lesion having been very small.

2. Cases similar to the above, but where the remains of the tubercular disease is not at all or only imperfectly calcified. Although the physician, from the examination of the chest, and the consideration that all the symptoms of phthisis have disappeared, may regard such cases as cured, they cannot be so considered by the pathologist. The latter knows from the microscopical examination of such foci, and from the results of inoculation experiments with animals, that such foci are dangerous, and may at any time give rise to further destructive changes in the lungs or to the general miliary tuberculosis. They are cases, however, which, if the person remains under favorable conditions for preserving health, may pass on to a complete cure, and then deserve a place in Class 1.

3. Cases which run a prolonged course, often with periods when the disease remains quiescent, and which are characterized pathologically by the formation of much fibrous tissue. It is some of these cases which are so misleading to the medical man, and cause the hopes of the sufferer not only to be raised, but cause him to believe that he is cured. This feeling is a consequence of the disease having become temporarily arrested, or, as is probably more frequently the case, by its progressing extremely slowly and being associated with few physical signs and symptoms of extending disease. Very many cases of phthisis come under this heading, and it is rare for a case of chronic phthisis to be continually progressive. Nearly all such forms of the disease are associated with periods of relative good health when the disease appears to be quiescent. The fact that many cases of phthisis belong to this class renders any conclusions as to the good effects of any particular treatment so fallacious. The enthusiastic therapeutist is very prone to conclude that the favorable results are the consequence of the treatment adopted, and to forget that the favorable symptoms and signs may be explained as manifestations of the natural course of the disease. The history of the treatment of pulmonary tuberculosis is full of such fallacies.

From a consideration of the above classes it follows that some cases of phthisis are completely cured, but that the disease in such instances has never been a very extensive one. The majority of cases of phthisis we are compelled to consider belong to the last-mentioned classes, and consequently to be cases which often show a tendency to cure, but rarely perfectly attain that end. The tendency, however, in very many cases of phthisis is towards arrest; and it is the evidence on this point, together with the absolute proof which we have, that in some cases a complete cure does result, that gives us encouragement to persist in treatment, and warrants us in holding out good hopes of recovery to the unfortunate sufferers in the early stages of the disease.

EXPERIMENTS ON THE FEEDING OF HOGS.

THE following is a summary of experiments made by the Illinois Experiment Station at Champaign during the years 1888, 1889, and 1890.

In eight trials in which corn only was fed, aside from salt and coal slack, pigs varying in average weight from 65 to 290 pounds and kept in pens or small lots without grass, gained at the rate of from 10.46 to 14.73 pounds per bushel (56 pounds) shelled corn, the average gain being 12.36 pounds. The rate of gain for food eaten, and the food eaten in proportion to weight, decreased after four to six weeks feeding with corn only. The corn eaten per day varied from 3.41 pounds, eaten by pigs averaging 65.58 pounds, to 10.71 pounds, eaten by pigs weighing 311 pounds. The corn eaten per day per 100 pounds live weight varied from 1.95 pounds eaten by pigs fed 84 days and averaging 207 in weight, to 5.19 pounds eaten by pigs averaging 65.58 pounds. In one case in the fourth week of pen feeding two pigs gained 3.21 pounds each per day — at the rate of 16.81 pounds per bushel of corn. This was the greatest gain per day, and was also the best rate of gain in any trial. There seemed to be no constant relation between the weight of the pigs or the season of the year, and the food eaten or the gains made.

In four trials, pigs fed all they would eat of shelled corn, with blue grass pasture, ate 4,216.5 pounds of corn and gained 905 pounds, which was at the rate of 12.04 pounds gain per bushel of corn. Pigs under like conditions, except that they were fed but half as much corn, ate 2,190 pounds of corn and gained 505 pounds, which was at the rate of 12.93 pounds per bushel. Pigs in dry lots, fed shelled corn, ate 4,207 pounds of corn and gained 790.5 pounds, which was at the rate of 10.52 pounds per bushel.

After periods varying from six to nine weeks, the pigs which had been fed a half ration of corn on pasture, were given a full feed of corn, the others being fed as before. In three trials lasting four or five weeks each, the pigs which had had a full feed of corn throughout ate 1,796 pounds of corn, and gained 329 pounds, which was at the rate of 10.11 pounds per bushel. Those which had been fed a half-feed of corn in the first part of the trials ate 2,075.5 pounds of corn in the second part, and gained 462.5 pounds, which was at the rate of 12.5 pounds per bushel. Those fed corn only ate 1,624.5 pounds of corn and gained 224 pounds, which was at the rate of 7.44 pounds per bushel.

In two trials pigs fed soaked corn ate more and gained more than those fed dry corn. In one trial they gained more, and in one less, in proportion to food eaten than those fed dry corn. The differences were not great in either case.

Two pigs in a pasture in which were three yearling steers were fed corn, gaining in 24 weeks 195 pounds. In a second trial two pigs with like conditions gained 231 pounds in 31 weeks. In neither case was the gain large. In each case the pigs at the close of the trial were in good condition for full feeding and made large gains when so fed.

A trial of apple pomace as food for pigs resulted unsatisfactorily. The pomace kept well. Chemical analysis of it showed an apparently good composition for feeding purposes; but the pigs ate very little of the pomace.

HEALTH MATTERS.

Morning Cold Baths.

IN the past few years several patients have come to me, says a medical writer in the London *Lancet*, complaining that they from time to time, especially in winter, in the early part of the day, have expectorated mucus tinged with blood. In each case there was no family history of phthisis, the temperature was normal, there were no bacilli discoverable in the sputa, there was no loss of strength or weight, and the chest-sounds were healthy. The men, however, were not of a vigorous type, and they were all accustomed to have a cold bath summer and winter. It seemed likely, especially in winter, that the sudden application of intensely cold water to the whole surface of the skin too suddenly raised the internal blood-pressure, and hence the oozing of the blood through the walls of the capillary vessels lying beneath the lining membrane of the throat or larynx, or possibly the lungs. In any case, whatever the true explanation may be, the fact stands out that the unpleasant symptom disappeared as soon as the temperature of the icy cold water was reasonably increased. The practice of taking a cold bath is so universal nowadays that it is perhaps as well to know that although the strong man may indulge in it with unmixed benefit, it may cause in the weak man a symptom which fills him with anxiety.

Lannelongue's Treatment of Tuberculosis.

The object aimed at by this method, as stated by the *Lancet*, is to bring about a sclerosis of the tubercular tissue, whatever may be its seat. The cases thus far treated have been mainly those of surgical tuberculosis.

Experiments have shown that chloride of zinc produces a remarkable fibroid change in the normal tissues of animals; and, as might be expected, the same fibroid transformation is brought about by the same agent in morbid tissues in general, including the tubercular. This chemical compound may be said to fix the anatomical elements by killing them, for it obliterates the capillaries and smaller vessels around where it has been deposited. An inflammatory action is thus set up in the vascular walls, which narrows the calibre of the surrounding vessels for a considerable distance from the initial point. But over and above this another local change of the highest import is brought about. Very rapidly — even within a few hours — there is produced in the altered tissues, by transmigration, and probably also by cell proliferation, an enormous afflux of new anatomical elements. These young cells cause fresh œdema of the periphery of the granulation growths, and infiltrate the tubercular neoplasm to the fullest extent. From this moment the struggle sets in between the accumulated elements and the bacilli, especially between the migratory cells and the microbes, to the detriment of the latter. However it may be as to the strife between cell and bacillus, the elements of the morbid growth which the chloride of zinc had destroyed are re-absorbed slowly, and finally disappear. The young cells, on the contrary, organize with great activity, and form a firm fibrous tissue, which is met with in appreciable quantity as early as the day next after the injection.

Following the sclerosis in articular fungosities, there is produced a thickening and subsequent condensation of osseous tissue if the periosteum be involved in the reparative process, as was the case in the examples of osteo-arthritic disease cited by the author. The remote results, so far as it is yet possible to judge, show a marked tendency for the sclerosed elements to be replaced by a more pliable connective tissue. As a consequence, the diseased parts regain their suppleness and their form, while locomotor functions are preserved entirely, or at least to the limits present at the beginning of the treatment.

The Artificial Production of Dental Caries.

For the past year Mr. Sewill, following other experimenters in the same field, has been endeavoring to produce caries in extracted teeth; and certainly the microscopical appearances presented by the sections shown at the Odontological Society, says the *Lancet*, differed but little from those of natural caries. He found that the best mixture of organic substances for the purpose was one part of bread to eight of saliva. Meat with saliva remained alkaline, and if a small quantity of acid were added became again rapidly alkaline. Albumen, whether as white of egg or other forms, acted in the same way. Saliva and starch produced little acid, which was soon exhausted.

The teeth were immersed in the mixture in glass-stoppered bottles, and kept at a temperature of 35° to 37° C. The bottles were unstoppered about once a day for examination; this, of course, admitted air, and if the mixture became putrid, it at once showed an alkaline reaction, in which case the teeth were taken out, well washed, and the mixture renewed. The mixture became rapidly acid, and remained so (unless putrefaction to a large degree supervened) for from three to five weeks. The acids present were acetic and lactic; of the former 5 per cent and of the latter 0.5 per cent were found after three weeks. The effects upon the tissues were precisely the same, both macroscopical and microscopical, as in natural caries. As in natural caries, the decay was found to commence most readily in places where there was ill-formed enamel or flaws or fissures which allowed access to the dentine, in which tissue the caries progressed more rapidly than in enamel. Cementum resisted longer than enamel, but at length yielded, and allowed the dentine beneath to be invaded. Discoloration was often present, and it was found that carious dentine readily took up stains from such substances as are often admitted to the mouth in medicines or articles of food. Microscopically the translucent zone is well shown, also the "pipe-stems" appearance in transverse sections, and the dentinal tubes are filled with micro-organisms, just as in natural caries.

The conclusions that Mr. Sewill draws from these experiments, and from the facts that caries takes place in natural teeth which are used as artificial substitutes, are, that caries is entirely due to external agents, and that vital action in no way modifies the disease.

NOTES AND NEWS.

The university extension work has been organized in Chicago. Cleveland, Indianapolis, Fort Wayne, and Altoona are among the latest applicants for branches.

— Accessions to the membership of the Society for the Extension of University Teaching continue to be sent in at the rate of nearly a hundred a week. The best indication of the national character of the work is found in the wide area from which these applications are received, every State in the Union being now represented on the rolls.

— The work of the St. Paul (Minn.) Academy of Science continues to meet with increasing support and encouragement. The museum is receiving many additions, its rooms being permanent and well adapted for the purpose. Persons willing or desirous of adding to its collections by loan, gift, or exchange, are invited to correspond with Professor W. F. Phelps, chairman of the committee on museum, or with Mr. C. B. Scott, curator. It is gratifying to learn that the university extension classes, organized under the auspices of the academy, and conducted by professors from the State University, from Carlton College, and other near-by points, have proven quite successful and promise much for the future.

— The heavy sentence of four years' imprisonment, in addition to fines, imposed in France recently on four persons connected with the alleged sale of the secret of melinite to an English firm gives a new turn to that strange affair. It was recently announced by the French minister of war that M. Turpin, the inventor, and Captain Triponé, the agent of the English firm, really had nothing of value to the French government to negotiate for, and that the most important part of the invention — the means of exploding melinite after it has been united with another substance in the shell — remained in the sole possession of the government. This second substance, according to the New York *Times*, is cresilite, a nitro-cresol obtained from a coal-tar product; and after two-thirds of the space in the shell has been filled with it, melinite is rammed in — a fact which sufficiently indicates that both products can be safety handled, and can be exploded only by a powerful detonator.

— In its latest report the Board of Health of the city of Boston says: "We are of the same opinion now as we were when we made our last annual report, that the large expense to the city, and the perpetual nuisance which attends the storing and handling of garbage, should be abolished by burning it in the kitchen, where it first appears as waste, and before decomposition has begun to make it offensive. By this method the only expense to be incurred would be the purchase of the pail or other attachment for the kitchen range, which would be less in a term of five years than the present cost of receptacles for storing the garbage. It is a mistake to throw this material upon the fire, for then the combustion is imperfect, and very offensive odors are given off. It should always be placed in a receptacle specially and conveniently arranged for the purpose, in some part of the stove. The ordinary heat of the stove will dry out all moisture and leave charcoal, to be burned like other fuel. There are several patented devices already in the market for this purpose. One of them is obtained only in the construction of the stove, and consists of a receptacle in the side of the stove in which the garbage is put, completely desiccated, and then dumped into the fire. Another consists of a small pail arranged for the purpose, can be applied to any stove, and is said to answer the needs well."

— At a recent meeting of the Chicago Medical Society, says the *Medical Record*, Dr. J. Frank reported a case where a man every July shed his skin. He was taken with feverish tremors, increasing almost to paroxysms. He undressed, lay down, and within a few minutes the skin of the chest began to turn red. The redness rapidly extended over the entire skin, and the feverish tremors continued uninterrupted for about twelve hours. Then he arose, dressed, and walked about in perfect health. The skin now commenced to peel, and ten hours later it began to come off in great patches. From the arms and legs it could be pulled off exactly like gloves or stockings As the old skin came away a new epidermis, as soft and pink as a baby's, was revealed. This new skin was very sensitive; the patient has to wear softened gloves and moccasins for about a week. After the old cuticle had been entirely removed the finger and toe nails began to drop off — new nails literally crowding them out. Finally the change was complete, the man had a new skin and a new outfit of nails, and was ready to return to the mines. The shedding began in his first year and recurred every July thereafter.

— It is worthy of remark that the idea of university extension has taken root in other than English-speaking countries. A Danish correspondent writes to the Oxford *Gazette* in regard to work in Denmark: "About five years ago the undergraduates of the University of Copenhagen undertook to give free instruction to the working classes and others who were in need of such instruction. Courses were given in languages, natural science, and all subjects commonly taught in high schools. The rooms in which the instruction was given were lent free by the schools and other institutions. The movement succeeded, and after three years the organizing committee applied for and got State aid, to which, however, no conditions were attached. It was only an encouragement given to the brave efforts of the students. The undergraduates now give free legal advice through competent men, and the movement is extending in every direction. Branches of the central society in Copenhagen have already been established in the chief towns of Denmark, and it is only a question of time when the whole country will be covered by a network of similar instruction."

— Some time ago, says *Engineering*, Mr. Bryan Donkin made a number of experiments on the flow of heat through the walls of a steam engine cylinder, using for the purpose delicate thermometers. At a recent meeting of the American Institute of Electrical Engineers Professor E. H. Hall gave the results of some preliminary experiments on the same subject, made with a thermopile, consisting of a plug of iron, which was screwed into a $\frac{3}{4}$-inch hole in the cylinder, and had a small hole bored through its centre. Down this hole was passed a nickel plug attached at one end to a thin iron plate, which was also attached to the iron plug. The outer ends of the iron and nickel plugs were connected to a delicate galvanometer in the usual way, and the nickel was of course insulated from all contact with the iron save by the thin plate already mentioned. Three thermopiles constructed on this system were used. In the first the plate connecting the two elements was one-half a millimetre thick, in the second one millimetre thick, and in the third two millimetres thick. The engine cut off at about $\frac{1}{4}$ stroke, and ran at sixty revolutions per minute. It was found that using the plug with the one-half millimetre plate, the temperature at cut-off was below the maximum, and fell rapidly during exhaustion. The ebb and flow of heat in the cylinder walls was very evident. Heat rushes into these walls at admission, but at cut-off, begins to travel back into the cylinder again, and continues during exhaust to flow from the walls and to boil off any water that may be in the cylinder. Professor Hall thinks that there is evidence to show that in the case of the engine on which he was experimenting a layer of water remained in the cylinder walls from the previous stroke, thus increasing condensation.

— Captain Cowell of the British ship "Drumeltan" reports as follows to the Hydrographic Office on the use of oil in stormy weather at sea: "I have for eighteen or twenty years used oil-bags in heavy running, especially in running down the easting on Australian and New Zealand voyages from England; they have always acted well, the ship running considerably drier, with less sea on board. I have always used canvas bags, first filled with oakum and then the oil poured in. The bags are hung at each cathead with a rather long lanyard, so that it will sometimes dip in the water as the ship rises and falls. In my last voyage in this ship, in the Pacific, off Patagonia, I lay-to for seventy-two hours in a furious gale from west-south-west, but did not ship any heavy water; had one oil-bag at the weather cathead and another at the mizzen rigging, with long lanyards (4-masted ship). Nothing but spray came on board. I learned afterwards that a good many vessels were damaged in that gale, or rather hurricane. Two days afterwards (April 15, 1890), I myself passed the "Adamant," of Hamburg, dismasted and abandoned. I always keep two oil-bags filled with oakum, ready for oil at short notice, and I invariably destroy the old bags, as they are liable to dry hard and become useless."

— Referring to a statement which has been publicly made, that the adoption of electric lighting in place of gas at the office of the Savings Bank Department of the General Post Office, London, has been followed by a marked reduction in the amount of sick leave, the *Lancet* says it has good authority for believing that the statement in question is substantially correct. Although the time which has as yet elapsed — two years — since the introduction of the new illuminant has been insufficient for the collection of trustworthy statistics, the paper named thinks there is every reason to believe that electric lighting will prove to be much more wholesome than ordinary gas flames. An electric lamp does not compete for the oxygen of the apartment in which it is placed, and this circumstance gives it a marked advantage over any open flame. It cannot, like some forms of gas-burner, be used to promote ventilation; but in ordinary situations its harmlessness is a much more important property.

— An antiquarian find which will excite interest all over Europe, says the *Academy*, has lately been made in Rœvemose peat bog, near Hobro in Jutland, Aalborg Amt. The objects are all of silver, the principal piece being a very large basin, on which have been fastened plates of silver hammered out with figures of men, women, and animals. The basin is twenty-six Danish inches in diameter, but scarcely eight inhes high. One or two pieces are apparently wanting; but it is hoped they will turn up when the moss is minutely examined. The eye-holes of the figures are now empty, but had evidently been filled with colored glass. One of the plates, which is nearly seventeen inches long, shows warriors, with helmets and other ornaments. One figure is a god with a wheel at his side, and on another are two elephants. A third shows a horned god in a sitting posture with his legs crossed orientalwise. All these have apparently nothing to do with Northern mythology, as was at first supposed. The whole find has now reached the Danish National Museum, and we see that these pieces belong to the god-lore of the Gallic peoples. The god with the wheel, for instance, is the Gallic sun god. The whole is the work of a Gallic artist at that early period when the Roman and Gallic peoples first came in contact. Allowing time for these things to wander so far north, the date would seem to be, as regards Denmark, the first century before Christ. Other things belonging to this Gallic group have been found previously in this country. The total weight of precious metal hitherto exhumed is about twenty Danish pounds.

— The attendance at the lectures of the Society for the Extension of University Teaching for the past season, as reported from the general offices of the society at Philadelphia, was exceptionally large, as compared with any previous experience either in this country or England, and, as a result, many may hesitate to form centres because they see no prospect of getting two or three hundred to follow the lectures of the course. Perhaps it may be well in this connection to notice the fact that in the printed report of the London society the average number present at each lecture in many centres is found to vary between eight and fifty. In many cases, certainly, the attendance was much larger, but it is by no means clear that the smaller centres were not fully as successful in several important particulars. It has been observed, for example, that the percentage of those in attendance at the lectures, who also took part in the class work, was greater in the smaller groups. Since so many of the benefits of extension work are dependent upon a participation in the lectures by the class, one must conclude that proportionately the smaller centres were more successful. Wherever there are a score of persons who wish to hear a given course, there should be no hesitation on account of the small numbers. Better results in many ways will be obtained under these circumstances.

— During recent years a good deal has been said amongst marine zoölogists of the use, as a food supply, that might be made of the enormous numbers of copepoda that swarm in the surface-waters of the sea, says a Norwegian correspondent of *Nature*, and the Prince of Monaco has pointed out the value this widely-distributed nutritious matter might have to shipwrecked sailors; but I am not aware that any one has yet actually made the experiment of cooking and eating copepoda, so the following record may be of some interest. While tow-netting during the last few days about the North Cape, we have had some large hauls of copepoda; and it occured to us last night, while watching the midnight sun off the entrance to the Lyngen fjord, that one gathering might be spared from the preserving bottle and devoted to the saucepan. We put out one of the smaller tow-nets (3½ feet long, mouth one foot in diameter) from 11.40 P.M. to midnight, the ship going dead slow, and traversing in all, say, a mile and a half during the twenty minutes. The net when hauled in contained about three tablespoonfuls of a large red copepod (*Calanus finmarchicus*, I think), apparently a pure gathering — what Haeckel would call a monotonic plankton. We conveyed our material at once to the galley, washed it in a fine colander, boiled it for a few minutes with butter, salt, and pepper, poured it into a dish, covered it with a thin layer of melted butter, set it in ice to cool and stiffen, had it this morning for breakfast on thin bread and butter, and found it most excellent. The taste is less pronounced than that of shrimps, and has more the flavor of lobster. Our twenty minutes' haul of the small net through a mile or two of sea made, when cooked in butter, a dishful which was shared by eight people, and would probably have formed, with biscuit or bread, a nourishing meal for one person. It would apparently, in these seas, be easy to gather very large quantities, which might be preserved in tins or dishes, like potted shrimps.

— The annual meeting of the Society for the Preservation of the Monuments of Ancient Egypt was held last week, says *Nature* of July 23, in the rooms of the Society of Antiquaries at Burlington House. Lord Wharncliffe, president, occupied the chair. The report stated that there was little to report of success attending the proceedings of the society for the past year. Its energies had been directed principally to two points, the necessity for an official inspector or superintendent in Egypt, whose duty should be the care of the ancient monuments, and an endeavor to do something towards arresting the gradual destruction of the Great Temple at Karnak. Reports concerning a proposed scheme for barring the Nile below Philæ, to make a vast reservoir for purposes of irrigation, had appeared in the public papers from time to time, and recently various more definite communications had been received by the committee on the same subject. The result would be, it was acknowledged, to completely cover this beautiful island and temple with water. There had been some correspondence on this subject with the authorities in Egypt; but as nothing had as yet been decided as to any scheme of irrigation, and as a committee would be appointed to consider the whole question, it might be considered as suspended for the present, and the committee had thought it best to wait before taking any further action; but they would not lose sight of this important matter, and would oppose to the utmost of their power any engineering scheme which would involve injury or destruction to this world-renowned spot. General Donnelly moved the adoption of the report; and the motion was seconded by Sir Edmund Henderson, and agreed to. The committee for the coming year was then elected, and a discussion subsequently took place as to the proposed scheme for barring the Nile below Philæ, the opinion of the meeting being evidently strongly opposed to the adoption of any system of irrigation which should involve damage to the temple. Mr. J. Bryce, M.P., spoke of the wanton injury which was often inflicted on monuments in Egypt, and said that he thought it would be necessary, in dealing with that matter, to bring the question of jurisdiction to the attention of those from whom any system of inspection or care was to emanate.

— The most remarkable example of reclamation by means of artesian well-water, says United States Irrigation Commissioner Hinton, in an official report, is found in the desert provinces or departments of Algeria under the French rule. The area, officially given, of French Algeria, is 184,465 square miles. The outlying portion is put at 135,000 square miles. In this total of over 329,415 square miles one-half belongs to the Sahara or desert. The European population in 1887 was about 250,000; the natives and naturalized were 3,328,549, making a total of 3,578,549. Cultivation by means of flowing well-waters has been sedulously fostered by the French colonial government for both political and economic reasons. Such wells as a means of reclamation began systematically to be bored in 1857, the French engineer M. Jus having demonstrated in 1856 that the desert was endowed with large supplies of underground water. The total number of wells that have been bored since that date in the departments of Algiers, Oran, and Constantine is stated at 13,135. These wells range from 75 to 400 feet in depth, and the low pressure common to the majority of them forces the water to a distance of about two feet above the ground. The waters are then collected in small ditches, which convey them to the vineyards, date-trees, and fields of durra, millet, wheat, etc., which comprise the chief products. In all, about 12,000,000 acres have been reclaimed in this way. The government bores are at least one-tenth of the whole number. As an illustration of the reclamation brought about by this well irrigation, the following figures from a report made in 1885 will be of value, but they relate solely to the cultivation of the grape for wine-making purposes. In the province of Algeria there are 60,322 acres; in Constantine, 25,021 acres; in Oran, 26,114. Under this species of cultivation Algeria is becoming a great wine-growing country. It sent to France during eleven months of 1886, 10,513,966 gallons of wine; and of cider in the same year, 219,277,124 gallons were made. The date-palm is the largest product of the desert oases proper. The total area under colonization or settled occupation in 1887 is given at 49,400,000 acres; under cultivation by irrigation in wheat, barley, oats, vines, olives, dates, tobacco, etc., at 17,041,133. The forest plantations cover 5,000,000 acres.

— Professor Louis Bevier of Rutgers College has been appointed to organize the work of university extension in connection with that institution.

— Professor Jeremiah W. Jenks of the University of Indiana has accepted the chair of social, political, and municipal institutions in Cornell University.

— W. F. Durand, late of the Agricultural College of Michigan, is now professor of mechanical engineering at Pardue University, Lafayette, Ind.

— Professor A. T. Woods, well-known as a writer on mechanical topics, has resigned the professorship of mechanical engineering in the Illinois State University to become professor of dynamic engineering in Washington University at St. Louis.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

THE PREPARATION OF MACARONI IN ITALY.

MACARONI is the *semoule*, or flour of wheat, moistened with water, kneaded until it assumes the requisite consistency, cut or pressed into the desired shape, and thoroughly dried. When wheaten flour is agitated in a large quantity of water, the starchy substances are dissolved, leaving a tough fibrous mass, which is gluten. Gluten contains nitrogen, while starch does not; hence the *semoule* or flour that contains the most gluten is the most nutritious. As compared with gluten, starch has but little strength; hence macaroni that is rich in gluten is not only the most nutritious, but is stronger, thereby preserving its shape while being dried and cooked.

The United States Consul-General at Rome says that for the best macaroni, the hard, semi-translucent varieties of wheat grown in warm countries, which contain a large proportion of gluten, are used in the form of *semoule;* for the cheaper grades common flour is used. Any intermediate grade can be made by mixing the two in various proportions. There are no statistics giving the quantity of macaroni made in Italy; but, as it constitutes one of the chief articles of food, the quantity must be exceedingly great. There are many large establishments manufacturing it by steam-power, and probably many thousands worked entirely by hand-power, and employing from three to five or six hands each. It is also an article of daily household production in a large proportion of Italian families. In the household the appliances are exceedingly simple — a smooth board, a piece of marble for kneading, and a common rolling-pin. One pound of flour is mixed with four or five eggs, moistened with hot water, kneaded a few minutes, and then rolled out very thin with the rolling-pin. After drying on the kneading-board for fifteen or twenty minutes, until the surface loses its adhesiveness, it is rolled up tightly, and thin slices are cut from the ends. The slices falling apart constitute strings of macaroni, and are ready for use. The macaroni factory which is worked by hand often consists of but one room, exclusive of the drying-rooms. The proprietor, with one or two workmen, makes the macaroni, and the wife sells it. The machinery is inexpensive, and the hired labor costs but little.

Artificial heat is seldom employed for drying, but the manufacture is often carried on in connection with the baking business. In this case, the drying-rooms would be above the ovens, and warmed somewhat by the waste heat. The result is, that these small establishments can successfully compete with the larger factories that are worked by steam-power. Their machinery generally consists of a mixer, a kneader, and a press. The mixer may be described as a semi-circular trough, having a hinged cover. Through the trough runs an iron shaft, having a number of projecting arms, with a crank on one end. About one hundred pounds of *semoule* or flour, or a mixture of both, according to the quality of the macaroni desired to be produced, is placed in wooden troughs, that stand in front of the mixer. To this is added a sufficient quantity of water, at about 160° F., containing in solution a small quantity of saffron, to give the macaroni the desired color. It is then mixed by hand for a few minutes, in order to fairly distribute the water, after which it is put into the mixer. The lid being closed, a workman turns the crank for about twenty minutes, when the contents are found to be converted by the action of the arms attached to the crank shaft, into a stiff dough.

From the mixer the dough is taken to the kneading-table. This is made in a number of ways. One of the most common in the neighborhood of Rome consists of a kneading-plank about forty inches long, thirty-two inches wide at the inner end, and forty inches at the outer end, with sides to keep the dough from falling out. It is solidly made of hard wood two and a half to three inches thick, and firmly attached to the floor and wall. The kneading is generally done by two or three men with a long bar attached by a swivel joint to the wall at the back of the table. This bar is about sixteen feet long, ten inches deep next to the wall, and three inches at the other end. The part next to the dough is bevelled to the shape of a blunt wedge with a rounded edge. The bar is worked up and down on the dough, and being fastened at the end exerts a tremendous and crushing force. Being made of a tough, elastic wood, it both readily sustains the full weight of the men when pressed down, and springs back above the dough sufficiently to allow it to be moved a little, and brought down on another part. This kneading continues for about twenty-five minutes, when the dough is ready for the press.

In some places the table is a straight plank about eight to ten feet long and fifteen inches wide, with sides to hold the dough in position The kneading is done by means of a drum about four feet in diameter, and the width of the plank. It is worked backwards and forwards by means of an upright capstan, about twelve inches in diameter, with a rope coiled round it and around suitable mechanism on the drum.

As soon as the dough is in a suitable condition, it is taken to the press, which consists chiefly of a cylinder about eight to ten inches in diameter, and twenty to twenty-four inches long, a plunger that fits the interior accurately, and a die plate that rests on a shoulder cast on the lower portion. The plunger is forced down by a screw, which is suitably connected, by working with a crank by hand. While one man mixes the dough, another turns the crank to press it, and the third takes the macaroni as it leaves the dies, cuts it into suitable lengths, and hangs it on light cane or bamboo sticks about five or six feet in length, ready to be carried to the drying-room. The press is heated to about 160° F. by means of a small pot of live coals, which is placed inside the cylinder a few minutes before pressing begins. From the presses the long macaroni is carried on light bamboo sticks to the drying-rooms. The small and fancy shapes are dried on screens. These are wooden frames about two feet by six, covered with a coarse cloth, so as to allow the air to freely circulate. A brace across the middle of the frame serves as a handle. The small and fancy macaroni is made in horizontal presses. Cutters revolving more or less rapidly near the face of the die, according to the length required, cut it into any desired length. The speed of the cutters is regulated by a pair of cone pulleys.

The drying of the macaroni is the most difficult and delicate part of the manufacture, and depends much upon the state of the atmosphere. It is first dried in the open air, the time in the sun or shade depending on the temperature and dryness of the atmosphere, from half an hour to three hours; the time also depends to some extent on the size of the macaroni. It is then carried to a close damp room, where it remains about twenty-four hours. If the room is not sufficiently damp it must be kept so by artificial means — by small steam jets or by the evaporation of water. It is sometimes covered with cloths during this stage to prevent drying too rapidly. The rest is a retarding process, and is intended to prevent the surface of the macaroni from drying too fast, and to allow the interior to harden. If the macaroni is not allowed to rest at this stage, it is liable to crumble or split. From the resting rooms it is carried to large spacious rooms that have thorough ventilation, either natural or artificial. It is estimated that for each man employed in the steam factories, about 170 to 200 pounds are produced per day.

REMARKS ON AN ACT FOR THE PREVENTION OF BLINDNESS.[1]

"SECTION 1. Should one or both eyes of an infant become reddened or inflamed at any time within four weeks after its birth, it shall be the duty of the midwife, nurse, or person having charge of said infant, to report the condition of the eyes at once to some legally qualified practitioner of medicine of the city, town, or district in which the parents of the child reside.

"Section 2. Any failure to comply with the provision of this act shall be punishable by a fine not to exceed one hundred dollars, or imprisonment not to exceed six months, or both.

"Section 3. This act shall take effect on the first day of June, eighteen hundred and ninety-one."

This act for the prevention of blindness was passed by the last legislature [of Maine], and was signed by the Governor, March 28. The legislature of New York passed an act similar to this one last year, and was the first State to have a law of this nature upon its statute books. Maine follows the lead and has the honor of being the second State in the Union to have such a law.

It is intended to draw attention more forcibly to purulent inflammation of the eyes, known also as ophthalmia neonatorum or purulent inflammation of the new-born. This disease is always caused by contagion or infection. It will be seen at once that it can be placed among the preventable diseases, and therefore the prophylactic treatment is one of the most important and satisfactory problems in hygiene, because in a large majority of cases the disease can be prevented from spreading. If, however, the disease does spread, and is recognized upon its first appearance, we possess remedies that can be applied by any physician and the disease can be cured at once. It would seem, therefore, that we need some law to call attention to the importance of the early treatment of the infant's eyes that blindness may be prevented, for every blind person represents a certain loss of productiveness to the State, and many are throughout their lives dependent upon relatives or the public for support.

If from twenty to thirty per cent of blindness in the State is due to neglect of proper treatment of this disease, all will agree that it is time something was done to place the neglect of such treatment upon some responsible person. This act for the prevention of blindness will do another good thing by calling attention to the prophylaxis of this disease. Proper treatment will be instituted before and after the birth of the infant in order that the eyes may not become infected, and thus the sight of many will be saved. To indicate how efficient this treatment is, it might be mentioned that after Credé had devised his method of prophylaxis for this disease, he had only two cases in 1,600 infants, whereas, before he practiced his method he had 10.8 per cent of the infants affected with it, which in this instance would be equal to 160 infants, some of whom would become blind in spite of the best treatment then known. By Credé's method of prophylaxis and treatment for this disease no infant need become blind. This means the prevention of an enormous amount of misery and the saving of an enormous amount of productive energy in the United States, estimated at not less than $7,500,000 each year. This enormous loss of wealth to the United States is due to the ravages of a disease as surely preventable as any in medicine. Dr. Burnett of Washington estimates that the disease costs the country more in ten years than all the epidemics of yellow-fever and cholera for the past hundred years.

To itemize this account, we find that the cost of keeping a single blind person in our best managed institutions is $132 a year. This makes the cost of sustenance of our blind from this one disease alone about $2,000,000. If we add to this sum what these blind persons would produce if they were not dependents, and reckon their productive wealth at $1.00 per day on an average, we have the enormous sum of $7,500,000. Maine having about one-fiftieth of the blind of the United States shares about one-fiftieth of the misery and loss of productive energy from this disease, which equals $150,000, according to this estimate.

It is our duty to do something to prevent this misery and loss to the State. At the clinic of the Maine Eye and Ear Infirmary many of the bad results of this disease are seen, persons crippled for life, and these defects of the eye are classified under various names giving little or no idea of their origin. These clinics remind one, like those of similar institutions, that not one-half of the misery or loss of productiveness is represented by those who have lost their sight from this disease, for where one has been made blind by it many have been more or less seriously affected in one or both eyes, so that the course of their lives has been changed from one of probable comfort and usefulness to a miserable existence. The statistics do not include this numerous class of persons. But they, as well as those who have been made blind from this disease, appeal to our better nature to do something for them. It will need but a short time to cure the affection if the infant is brought, on the first appearance of the disease. We are backward in this country as compared with some European countries.

In London there is a society for the prevention of blindness which does good work by directing attention more forcibly to the causes which produce this unfortunate disease.

The Ophthalmological Society of the United Kingdom, which is composed of the ablest men from all parts of England, Ireland, and Scotland, took up this subject in 1884, and appointed a committee of the leading men of the society, who unanimously reported that it was a subject for governmental interference.

In Germany, France, and Switzerland stringent regulations have been adopted, which demand of the nurse or person having charge of an infant to report any reddened or inflamed condition of the eyes at once. Three years ago the American Ophthalmological Society appointed a committee to investigate this subject and make a report, which they did last year. They recommended that each member of the society do all he could to have laws enacted that would call the attention of the public, and particularly of those having charge of infants, to the great importance of early treatment of the eyes, should any inflammatory symptoms arise.

[1] Dr. E.E. Holt of Portland, Me., in The Sanitary Inspector.

EXPERIMENTAL RESEARCHES ON MECHANICAL FLIGHT.

THE following is a translation of a communication made by Professor S. P. Langley to the Paris Academy of Sciences on July 13, and published in *Nature* of July 23: —

I have been carrying out some researches intimately connected with the subject of mechanical flight, the results of which appear to me to be worthy of attention. They will be published shortly in detail in a memoir. Meanwhile I wish to state the principal conclusions arrived at.

In this memoir I do not pretend to develop an art of mechanical flight; but I demonstrate that, with motors having the same weights as those actually constructed, we possess at present the necessary force for sustaining, with very rapid motion, heavy bodies in the air; for example, inclined planes more than a thousand times denser than the medium in which they move.

Further, from the point of view of these experiments and also of the theory underlying them, it appears to be demonstrated that if, in an aerial movement, we have a plane of determined dimensions and weight, inclined at such angles and moving with such velocities that it is always exactly sustained in horizontal flight, the more the velocity is augmented the greater is the force necessary to diminish the sustaining power. It follows that there will be increasing economy of force for each augmentation of velocity, up to a certain limit which the experiments have not yet determined. This assertion, which I make here with the brevity necessary in this *résumé*, calls for a more ample demonstration, and receives it in the memoir that I have mentioned.

The experiments which I have made during the last four years have been executed with an apparatus having revolving arms about twenty metres in diameter, put in movement by a ten horse-power steam-engine. They are chiefly as follows.

(1) To compare the movements of planes or systems of planes, the weights, surface, form, and variable arrangements, the whole being always in a horizontal position, but disposed in such a manner that it could fall freely.

(2) To determine the work necessary to move such planes or systems of planes, when they are inclined, and possess velocities sufficient for them to be sustained by the reaction of the air in all the conditions of free horizontal flight.

(3) To examine the motions of aerostats provided with their own motors, and various other analogous questions that I shall not mention here.

As a specific example of the first category of experiments which have been carried out, let us take a horizontal plane, loaded (by its own weight) with 464 grams, having a length 0.914 of a metre, a width 0.102 of a metre, a thickness two millimetres, and a density about 1,900 times greater than that of the surrounding air, acted on in the direction of its length by a horizontal force, but able to fall freely.

The first line below gives the horizontal velocities in metres per second; the second the time that the body took to fall in air from a constant height of 1.22 metres, the time of fall in a vacuum being 0.50 of a second.

Horizontal velocities..	0 m.,	5 m.,	10 m.,	15 m.,	20 m.
Time taken to fall from a constant height of 1.22 metres..............	0.53 s.,	0.61 s.,	0.75 s.,	1.05 s.,	2.00 s.

When the experiment is made under the best conditions it is striking, because, the plane having no inclination, there is no vertical component of apparent pressure to prolong the time of fall; and yet, although the specific gravity is in this more than 1,900 times that of the air, and although the body is quite free to fall, it descends very slowly, as if its weight were diminished a great number of times. What is more, the increase in the time of fall is even greater than the acceleration of the lateral movement.

The same plane, under the same conditions, except that it was moved in the direction of its length, gave analogous but much more marked results; and some observations of the same kind have been made in numerous experiments with other planes, and under more varied conditions.

From that which precedes, the general conclusion may be deduced that the time of fall of a given body in air, whatever may be its weight, may be indefinitely prolonged by lateral motion, and this result indicates the account that ought to be taken of the inertia of air, in aerial locomotion, a property which, if it has not been neglected in this case, has certainly not received up to the present the attention that is due to it. By this (and also in consequence of that which follows) we have established the necessity of examining more attentively the practical possibility of an art very admissible in theory — that of causing heavy and conveniently disposed bodies to slide or, if I may say so, to travel in air.

In order to indicate by another specific example the nature of the data obtained in the second category of my experiments, I will cite the results found with the same plane, but carrying a weight of 500 grams, that is 5,380 grams per square metre, inclined at different angles, and moving in the direction of its length. It is entirely free to rise under the pressure of the air, as in the first example it was free to fall; but when it has left its support, the velocity is regulated in such a manner that it will always be subjected to a horizontal motion.

The first column of the following table gives the angle (α) with the horizon; the second the corresponding velocity (V) of *planement* — that is, the velocity which is exactly sufficient to sustain the plane in horizontal movement, when the reaction of the air causes it to rise from its support; the third column indicates in grams the resistances to the movement forward for the corresponding velocities — a resistance that is shown by a dynamometer. These three columns only contain the data of the same experiment. The fourth column shows the product of the values indicated in the second and third — that is to say, the work T, in kilogram-metres per second, which has overcome the resistance. Finally, the fifth column, P, designates the weight in kilograms of a system of such planes that a one horse-power engine ought to cause to advance horizontally with the velocity V and at the angle of inclination α.

α	V	R	$T = \frac{VR}{1000}$	$P = \frac{500 \times 4554}{T \times 60 \times 1000}$
45	11.2	500	5.6	6.8
30	10.6	275	2.9	13.0
15	11.2	128	1.4	26.5
10	12.4	88	1.1	34.8
5	15.2	45	0.7	55.5
2	20.0	20	0.4	95.0

As to the values given in the last column, it is necessary to add that my experiments demonstrate that, in rapid flight, one may suppose such planes to have very small interstices, without diminishing sensibly the power of support of any of them.

It is also necessary to remark that the considerable weights given here to the planes have only the object of facilitating the quantitative experiments. I have found that surfaces approximately plane, and weighing ten times less, are sufficiently strong to be employed in flight, such as has been actually obtained, so that in the last case more than 85 kilograms are disposable for motors and other accessories. As a matter of fact, complete motors weighing less than five kilograms per horse-power have recently been constructed.

Although I have made use of planes for my quantitative experiments, I do not regard this form of surface as that which gives the best results. I think, therefore, that the weights I have given in the last column may be considered as less than those that could be transported with the corresponding velocities, if in free flight one is able to guide the movement in such a manner as to assure horizontal locomotion — an essential condition to the economical employment of the power at our disposal.

The execution of these conditions, as of those that impose the practical necessity of ascending and descending with safety, belongs more to the art of which I have spoken than to my subject.

The points that I have endeavored to demonstrate in the memoir in question are —

(1) That the force requisite to sustain inclined planes in horizontal aerial locomotion diminishes, instead of increasing, when the velocity is augmented, and that up to very high velocities, — a proposition the complete experimental demonstration of which will be given in my memoir; but I hope that its apparent improbability will be diminished by the examination of the preceding examples.

(2) That the work necessary to sustain in high velocity the weights of an apparatus composed of planes and a motor may be produced by motors so light as those that have actually been constructed, provided that care is taken to conveniently direct the apparatus in free flight, with other conclusions of an analogous character.

I hope soon to have the honor of submitting a more complete account of the experiments to the academy.

OLD STANDARDS.

By a curious accident it has just been discovered that the standard yard and certain other measures and weights which were supposed to have been lost when the Houses of Parliament were destroyed by fire in 1834 are still in existence. The following account of the matter, condensed from a statement in the London *Times*, is given in a recent issue of *Nature*.

A reference to the contemporary records shows that after the fire the standard bars of 1758 and 1760 were both found among the ruins, "but they were too much injured to indicate the measure of a yard which had been marked upon them." The principal injury to both of the standards was the loss of the left-hand gold stud, but whether this was caused by the action of the flames or otherwise is not known. When the Palace of Westminster was rebuilt the bars were deposited in the Journal Office, and from that time until recently they seem to have been wholly lost sight of. Some time ago it happened to be stated in the lobby that one of the duties of the speaker was to inspect once in every twenty years the standards immured in the sill of the lower waiting hall. Inquiries at the standards department of the Board of Trade elicited the fact that, so far from any statutory requirement being imposed upon the speaker in the direction indicated, Section 35 of the Weights and Measures Act, 1878, which provides for the care and restoration of the parliamentary copies of the imperial standards, specially exempts the walled-up copy from periodical inspection and comparison. It was found, however, that in 1871 Speaker Denison took cognizance of the standards; and this fact was brought to the speaker's notice. While inquiries were being made as to Speaker Denison's inspection, an official in the Journal Office mentioned that when the contents of that office were recently being transferred to the new wing he had observed among the lumber some old weights and measures. These proved to be the missing standards. They were examined by Mr. Chaney, the superintendent of weights and measures.

The most important of the standards thus rescued from oblivion are the yard measures constructed by Bird in 1758 and 1760. The former was copied from a bar in the possession of the Royal Society, which was itself a copy of a standard preserved in the Tower; and the second was constructed under the directions of a committee of the House of Commons from the 1758 standard. "Each of these two standard yards consisted of a solid brass bar 1.05 inches square in section and 39.73 inches long. Near each end of the upper surface gold pins or studs 0.1 of an inch in diameter were inserted, and points or dots were marked upon the gold to determine the length of the yard." The other standards in the custody of the Journal Office are two brass rods answering the description of the old exchequer yard, and four weights supposed to be certain of the "copies, model, patterns, and multiples" ordered by the House on May 21, 1760, "to be locked up by the clerk and kept by him." The most important weight — the standard troy pound — is not among those now brought to light.

INHALATIONS IN THE TREATMENT OF PHTHISIS.[1]

THE history of inhalations in the treatment of phthisis is not an encouraging one. They have been widely employed and hailed as the most rational and effective mode of assailing the disease at its seat. But the results of this method of medication have not been commensurate with the expectations excited by it, and we imagine that of late it has been gradually falling into disfavor and disuse. Several potent objections have been urged against the method. First, it has been denied that the various antiseptic and germicide agents applied by inhalation succeed even in reaching the seat of the disease — viz., the submucus tissue of the bronchial mucus membrane — but are arrested often in the pharynx, oftener still in the larynx. Then it has been shown that, even assuming that the medicated atmosphere produced by one of the ordinary inhalers really reaches the seat of the disease, its impregnation with carbolic acid, creosote, thymol, or other such agent, is so exceedingly feeble as to leave no solid ground for anticipating serious benefit from its use. Further, many authorities urge with much force that if the phthisical patient be taught to rely upon inhalations the inevitable result will be a life of indoor invalidism and constant tinkering with his inhalers, a mode of existence sure to effect an amount of mischief more than sufficient to counterbalance the problematical advantages of inhalation.

There is much weight in the above objections, and until they can be satisfactorily met, the place of inhalations in the therapeutics of phthisis can not be an importont one. Professor Germain-Sée, in a recent paper presented to the French Academy of Medicine, has sought to overcome the first of the objections to which we have made allusion, viz., the failure of the medicated atmosphere to reach the actual seat of the disease. He recalls the researches made at various times into the action of creosote upon tuberculosis. This drug has had a remarkable and somewhat checkered career. Discovered in 1832 by Reichenbach, its true composition was first made known in 1853 by Gorup-Besanez, who showed that it consisted mainly of two substances, Gaïacol and créosol. It was in 1877 that Bouchard and Gimbert conceived the idea of its possible utility in phthisis, and made trial of it both *per primam viam* and hypodermically. Later, Fraenzel and Sommerbrodt in Germany made extensive trial of creosote, and reported benefit from its use.

Guttmann, in his researches in the year 1889, found that the saturation of the system with creosote arrested the development of the bacilli, and suggested that the best means of bringing the system thoroughly under the influence of the drug would be to submit the patient to an atmosphere saturated with creosote under pressure. This is also the method recommended by Professor Germain-Sée. He describes it as follows: "The patient is shut up in a metal chamber, hermetically closed, and compressed air, passed through creosote and eucalyptol, is made to enter slowly. The air in passing through these liquids is saturated, and arrives charged with a large quantity of these medicaments. The pressure must be slowly increased, and should not exceed a half atmosphere. The speed of delivery of the air saturated with the medicated vapors is from fifteen to twenty cubic metres per hour for a space of five cubic metres of capacity. The length of time the patient remains in the chamber is usually two hours, sometimes three or more, and no inconvenience ensues as the result of this procedure. The inhalations are made daily or more frequently."

Professor Germain-Sée has tried this method in twelve cases, of which one was a case of apical bronchitis, a second was a case of fœtid bronchitis, and the remaining ten were genuine cases of tubercular phthisis, all of which, with one exception, had arrived at the stage of softening. The results obtained appear to be surprising, a marked amelioration being in most cases observable, not only in the amount and character of the expectoration, but in the general constitutional condition, and in some cases, though not in all, a corresponding improvement in the physical signs. Contrary to what might seem probable, hæmoptysis was not only not excited, but seemed controlled by this mode of treatment, and the appetite and digestion were improved rather than otherwise. Hectic fever was also diminished. Naturally, the least improvement was manifested in the physical signs, but Professor Germain Sée is inclined to hope that by this new method the disease, if not cured, may at least be arrested, and further progress prevented. Benefit was obtained in some cases in a fortnight, in others the treatment was kept up for three months. Very great benefit was obtained in some cases of scrofulous enlargement of the cervical glands.

At the present time it is hardly necessary to emphasize the necessity for extreme caution in admitting the claims of any new alleged remedy for tuberculosis, and the evidence before us in the present case, although interesting, falls immeasurably short of demonstration. Further trials will no doubt be made, and the results will be awaited with attention. One benefit, somewhat negative in character, may even now be derived from Professor Germain-Sée's researches, viz., the realization of the utter futility of the methods of inhalation so long adopted, and the uselessness of the inhalers now commonly employed. If inhalation is ever to become a valuable agent in therapeutics, it will probably be by the adoption of some plan analogous to that sketched above, and, according to our present knowledge, the most hopeful medicament with which to experiment would seem to be creosote.

[1] From the London Lancet.

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.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Beech Trees and Lightning.

THE question was raised in *Science* a short time ago as to whether beech trees were ever struck by lightning. During a severe thunder-storm which passed over here this afternoon a beech tree within fifty yards of the house was struck, the upper part of the trunk and several of the branches to the end being stripped of their bark, but the lower part of the trunk showing no sign of passage of the lightning. THOMAS DARLEY.

York, England, July 21.

That Hessian Fly Parasite.

THE item concerning the introduction of a European parasite of the Hessian-fly into this State which is going the rounds of the press, and which I notice you have copied in your issue of July 17, was unauthorized, and is in some respects inaccurate.

The parasites were not obtained originally from the Smithsonian Institution, but were sent me by Dr. Riley, the entomologist of the United States Department of Agriculture, several other entomologists, as I understand, having received them at the same time. This was, in short, an experiment of the Division of Entomology, and not my own.

The parasite is *Semiotellus nigripes*, and, like our native species of the same genus, infests the larva, not the egg.

S. A. FORBES.

Champaign, Ill., July 20.

Information Wanted.

CAN I learn through the columns of *Science* how to interpret the indications of the thermometer with bulb blackened and inclosed in an exhausted glass case ?

Are there any accepted formulæ for this so-called solar radiation thermometer, and where can one find the literature of the subject? F. C. VAN DYCK.

New Brunswick, N.J., July 30.

BOOK-REVIEWS.

The History of Human Marriage. By EDWARD WESTERMARCK. New York, Macmillan. 8°. $4.

THIS is one of the most elaborate works on the history of social institutions that we have met with. The author is lecturer on sociology in the University of Finland at Helsingfors, yet his book was written by himself in English, which is to him a foreign language. He modestly tells us in his preface that, as originally written, the book contained some un-English expressions, which were corrected by his English friends; but the ease and clearness of the style show that he is a master of the art of expression, and make his work far more interesting than works on such subjects are apt to be. The word "human" in the title of the book is tautological; for there is no marriage known to us except the human, and Mr. Westermarck's attempt to show that the mating of animals is the same thing as marriage is by no means successful. Marriage is a moral institution, and therefore cannot exist except among moral beings; and Mr. Westermarck's failure to duly appreciate the moral aspects of his subject is the principal defect of his work.

As a descriptive history of marriage, however, in the many forms it has assumed, the work could hardly, in the present state of our knowledge, be surpassed. It opens with a discussion of the proper method to be pursued in this and similar inquiries, as to which the author is more prudent than some writers have been. He remarks that "nothing has been more fatal to the science of society than the habit of inferring without sufficient reasons from the prevalence of a custom or institution among some savage peoples that this custom, this institution, is a relic of a stage of development that the whole human race once went through" (p. 2). It was high time to sound this note of caution, and we trust that other inquirers into early history will give heed to it. Having settled on his method of investigation, Mr. Westermarck goes on to present the different phases of his subject, such as the antiquity of marriage, the hypothesis of promiscuity among primitive peoples, the influence of affection and sympathy, the forms of marriage, the ceremonies attending it, and many other matters pertaining to the marriage relation. He shows a very wide as well as intimate knowledge of the facts, so far as they have been discovered, and both his facts and his arguments will have to be considered by all who may write on the subject hereafter.

His opinions on certain fundamental points are at variance with those of most previous writers, and hence his work is likely to give rise to some controversy. He rejects the hypothesis that promiscuous intercourse was once everywhere prevalent, and his arguments on this point deserve careful attention. In some of his other theories he does not seem to us quite so fortunate. For instance, he maintains that there was in the earliest times a human pairing season similar to that of animals, the sexual passion being dormant the rest of the year; yet he brings no adequate evidence to support this view, and hardly any evidence at all. Again, in speaking of the prohibition of marriage among near kindred, he remarks that savages could hardly have known that such marriages are physically injurious to the race, and so he attempts to account for the prohibition by the principle of "natural selection." He thinks that "there was no doubt a time when blood relationship was no bar to sexual intercourse. But variations, here as well as elsewhere, would naturally present themselves; and those of our ancestors who avoided in-and-in breeding would survive, while the others would gradually decay and ultimately perish" (p. 352). But what we want to know is why some of our ancestors avoided such breeding while others did not; and it is no answer to this question to tell us that, after the two customs had been established, the one prevailed over the other. But whatever may be thought of some of Mr. Westermark's theories, his work will be indispensable to all students of the early history of mankind.

Justice. By HERBERT SPENCER. New York, Appleton. 12°. $.25.

THIS is intended to form the fourth part of Mr. Spencer's "Principles of Ethics," of which only the first part had previously appeared. Only the earlier chapters of the book deal with the general principles of justice, the bulk of it being devoted to their application. We cannot say that in our opinion the work is a success, the author's fundamental ideas being vague and inconsistent. His attempt to show that there is such a thing as "animal ethics" is hardly worth discussing; but when he comes to treat of human justice he lays down as its fundamental principle a proposition which will meet with little acceptance from philosophers. He maintains that "each individual ought to receive the benefits and the evils of his own nature and consequent conduct; neither being prevented from having whatever good his actions normally bring to him, nor allowed to shoulder off on to other persons whatever ill is brought to him by his actions" (p. 17). Now according to this rule, if a man in consequence of his own mistake meets with an accident that disables him, it is just for other men to leave him to perish; but most people would say it was unjust.

Mr. Spencer afterward modifies this principle somewhat by the provision that no man shall interfere with the freedom of others; and thus he reaches what he calls "the formula of justice," which is as follows: "Every man is free to do that which he wills, provided he infringes not the equal freedom of any other man" (p. 46). This is a familiar principle of the common law; and it is rather surprising to see it presented in this work as if it was something novel. It is by no means sufficient, however, as a universal rule of justice, as Mr. Spencer himself finds when he comes to deal with the rights of children; for if children were left to themselves merely, without help or interference from older persons, they would die. Accordingly Mr. Spencer falls back upon another principle, namely, the necessity of preserving the species, which makes it the duty of the parents to support and protect their offspring. Thus he lays down two quite distinct principles of justice, and he nowhere takes the trouble to reduce them to one nor to show how they are to be reconciled with each other. He fails, too, as all the associationists have failed, to account for moral obligation. Why should I refrain from infringing the freedom of others if it happen to be for my advantage to infringe it? and why am I bound to preserve the species? Mr. Spencer scarcely touches this question in the body of his work, but in the appendix he gives a few words to the subject in reply to a critic; yet he shows but a vague conception of what the problem is, and fails as completely as Mill did to solve it.

From the nature of Mr. Spencer's "formula of justice" it will be inferred that his work relates mainly to legal and political justice, and this is the case. Having obtained his formula, he proceeds to deduce from it the principal legal rights that men enjoy in civilized society, such as the right to physical integrity, the right of property, the right of free motion and locomotion, the right of free speech, etc.; and though his deduction is not in all cases quite satisfactory even to himself, it is in the main a success, except, as above stated, in the case of children. He next proceeds to deal with the constitution and functions of the state, and devotes several chapters to a reiteration of his views on the proper limits of state interference with the liberty of the individual, but without presenting anything new. Mr. Spencer's work will be welcomed by those who agree with his extreme individualistic views; but we doubt if it will contribute much to the ethics of the future.

AMONG THE PUBLISHERS.

THE J. B. Lippincott Company, Philadelphia, announce as in press "The Natural History of Man, and the Rise and Progress of Philosophy," a series of lectures delivered by Alexander Kinmont, A.M.

— Professor Arthur Sherburne Hardy has gone abroad for a year, and may, perhaps, go round the world.

— Professor Lyon G. Tyler of William and Mary College has in contemplation a political history of Virginia, for which he has already accumulated a large amount of material.

— H. H. Johnston is writing a book on Livingtone and Central African exploration, which will be illustrated from original drawings by Mr. Johnston and from photographs.

— "I desire to enter a plea for the child," says Henry Sabin in his book, "Organism and System" (Bardeen); "to recall the almost forgotten fact that the supreme object of the child's education is the child himself. Organization and system are but means to an end. 'What is the machine for?' finds its answer in the value of the product."

— The article upon "University Extension and its Leaders," which Professor Herbert B. Adams of the Johns Hopkins University prepared for the July number of the *Review of Reviews*, has been honored by receiving the first prize offered by the regents of the University of New York for an article upon university extension. The English edition of the *Review* last year offered a prize of $1,500 as a three-year college scholarship to the English girl who should pass the best examination in contemporary history and politics, the examination to be based upon articles and discussions appearing in the *Review* from January to December, 1890, inclusive. The award has recently been made, and in the American edition of the *Review* for August there appears an account of the prize and its award, together with portraits of the two young ladies between whom the first prize was divided, and of two others who won the second and third prizes. The "Progress of the World," in the August number, opens with a discussion of Chicago and the World's Fair, from the pen of Dr. Albert Shaw.

— The recent issues of the "Papers of the American Historical Association" contain some articles of interest. The double number for January and April has a paper by Mr. John Jay on the "Demand for Education in American History," in which he presents the well-known arguments for the necessity of such education, but without adding anything new. Mr. Charles M. Andrews discusses "The Theory of the Village Community" in a way that will not be gratifying to the school of Freeman and Maine; for he shows their views as the democratic constitution of the early communities has no real basis in fact and very little support from analogy. Mr. W. H. Mace has an article on the "Organization of Historical Material," which will doubtless be suggestive to young historians, though it contains nothing specially novel. There is also an interesting paper on Bismarck's career, with others on various topics. The July number contains a long and elaborate account of "The Fate of Dietrich Flade," who was a judge in the Rhenish town of Trier, and was put to death in 1589 for the then heinous crime of witchcraft. Professor Burr in this article, however, makes it pretty certain from newly discovered evidence that Flade's death was really due to the malice of his personal enemies. This number also has articles entitled "The Philosophic Aspects of History" and "Is History a Science," neither of which sheds much light on the subject, and closes with a paper by Mr. J. G. Bourinot on "Canada and the United States," in which the author takes strong ground against annexation. The "Papers" are published by Putnam at four dollars a year.

— Messrs. Macmillan & Co. announce that they are now issuing a new edition of "The Cambridge Shakespeare." This well-known text was originally published in 1863–6. It has been for many years out of print, and second-hand copies have only been procurable at high prices. A new and revised edition has long been contemplated, but has been postponed in order that Mr. W. Aldis Wright (the surviving editor) might go carefully over the whole work in the light of the most recent textual criticism of Shakespeare. This has now been done, and it is hoped that the Cambridge edition, which may now be considered as in its final form, may be found most satisfactory.

— Messrs. Funk & Wagnalls, publishers, announce that their new "Standard Dictionary of the English Language" will probably be issued early in 1892. In a recent presentation of the plan of the work, now well under way, the publishers state that it will embody many new principles in lexicography, and will contain nearly twenty-two hundred folio pages, with over four thousand illustrations made expressly for it. It will contain some two hundred thousand words. Among the hundred or more editors on the staff of the new dictionary we find the names of Professors F. A. March, Simon Newcomb, N. S. Shaler, W. B. Dwight, Thomas H. Huxley, E. E. White, F. Max Müller, and Daniel G. Brinton; also Otis T. Mason, Dr. T. Mitchell Prudden, Rear-Admiral Luce, Gen. O. O. Howard, Benson J. Lossing, Hon. Carroll D. Wright, Anton Seidl, Henry M. Stanley, H. H. Bancroft, Robert Grimshaw, Alfred Ayres, and Alexander Graham Bell. Among the chief distinguishing characteristics of the work, as set forth in the prospectus, are the following. In the definition of a word the most common meaning is given first, preference being given to the "order of usage" over the historical order; for showing the pronunciation a "scientific alphabet" is used, which has been prepared and recommended by the American Philological Association and the American Spelling Reform Association; disputed pronunciations and spellings are referred to a committee of fifty leading philologists, writers, and speakers; a committee of five representative scholars will pass upon all new words admitted; strictly obsolete and dialectic words, and such foreign words as are rarely used, are placed in a glossary in the appendix; handicraft terms are grouped under the various trades, the more important being also given in their vocabulary places. The German double hyphen is used in compound words; and the different parts of each science are so treated that the student can easily trace the definition of all its branches, and have before him the full meaning of the science; that is, while the terms belonging to each branch or subordinate branch of a science are defined in their proper vocabulary places, the references to their superior and subordinate branches are so given that the definition of the science as a whole can easily be traced and collected, and when so collected will be found by the student to be a full and harmonious exposition of the entire science.

— From Allyn & Bacon, publishers, Boston, we have received "Primary Batteries," a well arranged and practical little volume of nearly two hundred pages, by Henry S. Carhart, A.M., professor of physics in the University of Michigan. Notwithstanding the many works on electrical topics that have made their appearance in the past few years, the particular branch of the subject covered by Professor Carhart's book has been comparatively neglected, the only work devoted wholly to primary batteries available to English-speaking electricians and students, we believe, having been an unsatisfactory treatise translated from the French. In preparing this book the author has evidently had in mind the needs of the student of electricity as well as of those whose occupation requires some degree of familiarity with primary batteries for practical purposes, as the work is admirably adapted to the wants of both classes. The divisions of the subject appear to be as logical as the nature of the material permits, each being fully illustrated by the most useful types of cells. Prominence has been given to standards of electromotive force, and a chapter is devoted to testing, which will prove both interesting to the student and useful as a laboratory guide

— Professor Tyndall's health is improving to such an extent that he is preparing for the press a volume of essays, addresses, and reviews, to be issued under the title "Fragments of Science."

— Ginn & Co., publishers, announce for immediate publication "The Story of Our Continent," a reading book in the geography of North America, by professor N. S. Shaler of Harvard University, illustrated. The object of this book is to set before the student a simple explanation of the way in which the continent of North America has come to its present physical state, and at the same time to show how this physical state affects the life of the people. In other words, it seeks to secure a clear conception of the geography of the continent by showing in a very simple manner the geological evolution of its features. It is adapted to the needs of grammar schools, and may advantageously be used as a reader in connection with a regular text-book in geography. As an introduction, by the way of our own continent, to the study of geology and physical geography, it will be found to possess a peculiar value.

— *The Climatologist* is the title of a new monthly journal of medicine announced by W. B. Saunders, 713 Walnut Street, Philadelphia. The object of this journal will be to promote original investigation, to publish papers containing the observations and experience of physicians in this country and Europe on all matters relating to climatology, mineral springs, diet, preventive medicine, race, occupation, life insurance, and sanitary science, and in that way to supply the means by which the general practitioner and the public at large will become better acquainted with the diseases of this country and Europe, and better armed to meet the requirements of their prevention or cure. The editors are Drs. John M. Keating, F. A. Packard, and Charles P. Gardiner, who will have the co-operation of about thirty associate editors. The first issue, dated August, will be ready about the 10th.

— According to the *Publishers' Weekly*, Professor Lester F. Ward has received the distinction of having his book, "Dynamic Sociology," burned by order of a council of ministers of Russia.

Publications received at Editor's Office, July 22–Aug. 4.

ALLSOP, F. C. Telephones, their Construction and Fitting. New York, Spon. 191 p. 12°. $2.
COMSTOCK, T. B. Report on the Geology and Mineral Resources of the Central Mining Region of Texas. Austin, State. 100 p. 4°.
CUMMINS, W. T. Report on the Geology of Northwestern Texas. Austin, State. 94 p. 4°.
HYATT, A. Carboniferous Cephalopods. (Geol. Survey of Texas.) Austin, State. 30 p. 4°.
MAINE. Sixth Annual Report of the State Board of Health of the State of, 1890. Augusta, State. 306 p. 8°.
PETERMAN, A. L. Elements of Civil Government. New York, American Book Co. 218 p. 12°. 60 cents.
SPENCER, Herbert. Justice; being Part IV. of the Principles of Ethics. New York, Appleton. 291 p. 8°. $1.25.
STREATFEILD, F. W. Practical Work in Organic Chemistry. New York, Spon. 156 p. 12°. $1.25.
TEXAS, Geological Survey of. Reports on the Iron Ore District of East Texas. Austin, State. 326 p. 4°.
TEXAS, Second Annual Report of the Geological Survey of. Austin, State. 109 p. 4°.
U. S. GEOLOGICAL SURVEY. Topographical Maps of Portions of Alabama, Georgia, Illinois, Kansas, Kentucky, Maryland, Massachusetts, New Hampshire, New Jersey, North Carolina, Pennsylvania, Tennessee, Vermont, Virginia and West Virginia. Washington, Government. 15 maps. f°.
UNIVERSITY Extension. Vol. I., No. 1. *m*. July, 1891. Philadelphia, Am. Soc. for the Extension of Univ. Teaching. 32 p. 8°. $3 a year.
VON STREERNWITZ, W. H. Report on the Geology and Mineral Resources of Trans-Pecos Texas. Austin, State. 70 p. 4°.
WESTERMARCK, E. The History of Human Marriage. New York, Macmillan. 644 p. 8°. $4.

A Russian writer, Nicholaey, had obtained permission to translate the work, and the publisher Soldatenkoo had printed and published 1,200 copies of the first volume when the order for its confiscation and *auto-da-fé* was given. The publisher's loss will be over 3,000 roubles. Of course he will not attempt to publish the second volume, and it is more than likely that the manuscript will be seized and destroyed. Professor Ward thinks that the chapter advocating universal education may have been the cause of the Russian censor's objection to the book.

— The *Home Journal* of last week contained a four-column article which expounds and explains the important question of international copyright. It shows how the new law affects authors, publishers, printers, and readers on both sides of the Atlantic.

— There is in the London *Journal* of January, 1891, this reference to the establishing of the university extension movement in Austria: "A beginning has recently been made in connection with the Vienna universities and the 'Volksbildungs' (Society for Popular Instruction) to introduce the university extension system to the Austrian capital. Dr. Bauer, who visited this country in the summer, writes that a society has been formed, under the auspices of which courses of lectures have already been arranged in science, history, and economics, in various parts of the city, and on the eve of the coming census a series of lectures will be given on the 'Statistics of Population.' Lecturers have also been asked to give courses to the soldiers and officers in barracks. The majority of teachers are graduates of the university, or men of acknowledged literary or scientific training, and the work is thus of university stamp." The financial difficulty has quickly asserted itself, and it is proposed to apply for aid to the "Lantag" (provincial parliament), and any grant that may be forthcoming will be controlled by a "curatorium," consisting of certain members of parliament, professors of the university, and members of the society.

SCIENCE

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WALKER PRIZES IN NATURAL HISTORY.

The **Boston Society of Natural History** offers a first prize of from $60 to $100, and a second prize of a sum not exceeding $50, for the best memoirs, in English, on one of the following subjects:

1. An original investigation into any of the problems connected with the geology of the last ice epoch in New England; any of the glacial features, as, for instance, the distribution and history of morainal deposits and eskers, or of sand plains may be selected.

2. An original investigation into the recent changes of level of the whole or of a part of the shore line of the eastern United States. This inquiry must include observations on and discussions of the phenomena exhibited by elevated sea margins and submerged forests.

3. A study of any river valley in New England containing an area of not less than one hundred square miles; the inquiry to include the preglacial history of the stream, the changes effected in the basin by the last ice epoch, the relation of the valley to the neighboring basins, and to changes of level of the sea.

Each memoir must be accompanied by a sealed envelope, enclosing the author's name and superscribed by a motto corresponding to one borne by the manuscript, and must be handed to the Secretary on or before April 1st, 1892.

Prizes will not be awarded unless the memoirs are deemed of adequate merit.

For further particulars apply to

SAMUEL DEXTER, Secretary.

BOSTON, July 1, 1891.

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19. No response to date.

N. D. C. HODGES,
47 LAFAYETTE PLACE,
NEW YORK.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED a position as professor of geology or metallurgy by a school of mines graduate. Address T. W. O., 49th Street and Madison Avenue, New York City.

A SCHOOL, in a charming location, needs a lady teacher who would teach a portion of each day, five days a week, in return for her home in the institution for a year. The ordinary English branches. (She will be specially acceptable if she has any accomplishments, as Music, Art, Delsarte System.) MALE SCHOOL, care *Science*, 47 Lafayette Place, New York.

AN EDUCATOR of mature years and experience is open to engagement as President of a College or Normal School. Address "UNIVERSITY," care *Science*.

WANTED—Lyell's Principles of Geology, second-hand copy, 2 vol. ed., D. Appleton & Co. State condition and price. J. W. FRELEY, Wells College, Aurora, N. Y.

A PROFESSOR, native Frenchman, would accept a situation as companion-tutor in a family spending the summer in the country or abroad. Best pure Parisian accent. Rare opportunity to improve thoroughly the acquaintance laboriously acquired during the winter. First-class references. Address PROF. CATEAUX, Poughkeepsie, N. Y.

CHEMIST.—A chemist, with the degree of M.Sc., desires an engagement, either as chemist to manufactory, &c., or as professor of chemistry in a college or medical school. Has had experience as Professor of Chemistry and thorough chemical education in every branch of the science. Address M.Sc., this office.

WANTED—Four additional Teachers for the whole or part of the summer at the Summer School of Languages, Bryant School, Roslyn, L. I., N. Y. One of them at least should be a teacher of conchology and the botany and biology of the ocean, one a geologist, and one a native of France.

A CHEMIST, who has taken a thorough course in chemistry in one of our best institutions, would like a position as assistant in an iron firm or in any industrial establishment. Correspondence solicited. JOHN N. BARBER, Box 743, Amherst, Mass.

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[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Botanical specimens for exchange.—Special pains have been taken to procure good mountable specimens fit for any herbarium and no other are offered. E. E. Bogue, Orwell, Ohio.

For exchange or sale at a sacrifice, an elaborate microscope outfit. Bullock stand; monocular objectives, one-sixth homogeneous immersion, four-tenths, and three inch, Bausch & Lomb, also one-fourth and one inch Spencer. Four eye-pieces. Objectives are the best made. Address Mrs. Marion Smith, 41 Branch Street, Lowell, Mass.

For Exchange.—A collector of twelve years' experience has many fine duplicate minerals which he would like to exchange for others. Address John Holl. Rollo, Wilmington, Del.

I would like to exchange some twenty vols. of the Second Geological Survey of Pa., also a few U. S. Geol. Survey Reports, for State geological reports not in my library. Full particulars to those who offer. J. W. Freley, Wells College, Aurora, N. Y.

For sale, or exchange for geological works, the following works in anatomy, all latest editions: Allan, Tuain, Gray, Leidy, Massey, and Rollestin's Forms of Animal Life. S. W. Williston, Lawrence, Kan.

Will exchange a new Thomson reflecting astatic galvanometer, about 6,000 ohms, made by Clark, Muirhead & Co., London, and costing £30, with 1-9, 1-99, 1-999, shunts, lampand scale, for a Weston voltmeter and ammeter, or arge Wheatstone bridge, dial pattern, or a portable testing outfit. Address G. A., *Science* Office, 47 Lafayette Place, New York.

SCIENCE

NEW YORK, AUGUST 14, 1891.

THE SPACE-PENETRATING POWER OF LARGE TELESCOPES.[1]

UNLESS there is some small star or dimly shining body with a large parallax which has not yet been detected, our nearest neighbor amongst the stars is the double star α Centauri. It is situated about thirty degrees from the southern pole of the heavens, and therefore is not visible in England. The two stars together shine with a light which is a little greater than that of a first magnitude star, for the larger of these twin suns is ranked by Professor Gould as being exactly of the first magnitude of the photometric scale, and the smaller star is of the 3½ magnitude.

According to this photometric scale of magnitudes, which is now universally used, a star of the first magnitude gives just a hundred times as much light as a star of the sixth magnitude. Consequently, if the larger star of the pair, which is known as α^2 Centauri, were removed to ten times its present distance, it would appear as a star of the sixth magnitude; but this would only be the case if there were no loss of light in travelling from its more distant position. If there were any absorption of light in passing through such a vast distance of space it might appear smaller, and would probably not be visible to the naked eye, for few people see stars with their unaided eyes which are ranked as smaller than the sixth magnitude. According to the photometric scale, a star of any magnitude gives about two and a half times as much light as a star of the magnitude immediately below it. Thus a star of the sixth magnitude gives 2.512 times as much light as a star of the seventh magnitude, and a star of the seventh magnitude gives 2.512 times as much light as a star of the eighth magnitude. Consequently a star of the sixth magnitude gives 6.31 times as much light as a star of the eighth magnitude, and 15.85 times as much light as a star of the ninth magnitude, 39.81 times as much light as a star of the tenth magnitude, and 100 times as much light as a star of the eleventh magnitude.

Let us suppose that α^2 Centauri was removed to one hundred times its present distance, then, neglecting the absorption of light in space, it would shine as a star of the eleventh magnitude of the photometric scale, and would only just be visible with a telescope of two and a half inches aperture. This calculation is based on the assumption of Professor C. A. Young (Text Book of General Astronomy, sec. 822) that, for normal eyes, with a good telescope, the minimum visible for a one-inch aperture is a star of the ninth magnitude — an estimate which about corresponds to what might be expected from the diameter of the pupil of the eye.

I have measured the diameter of the pupils of several persons whom I believed to have keen sight, amongst others, the observing eyes of the Rev. T. W. Webb, Mr. Burnham, and the late Dr. H. Draper, and have found that about a quarter of an inch generally corresponds to the maximum dilation of the pupil in viewing faint objects. A telescope of one inch diameter would consequently collect about sixteen times as much light as would enter the pupil of the unassisted eye, and ought, with a suitable eye-piece, to show stars giving about one-sixteenth the light of a sixth magnitude star just visible to the naked eye. As we have seen above, a sixth magnitude star gives 15.85 times as much light as a ninth magnitude star of the photometric scale. Consequently, neglecting the absorption of light by the lenses, and the reflection from their surfaces, a one-inch telescope ought, with a suitable eye-piece (which collects and sends into the pupil of the eye the whole of the light from the object-glass), to render stars of the ninth magnitude just visible.

The power used with a telescope makes some difference, as it increases the contrast between the brightness of the star and the background on which it is seen, — the light of the background being dimmed by magnification, while the star in a good defining telescope is but slightly dimmed by moderate magnification. Thus Dawes found that he could see a star of the sixth magnitude with a telescope having an aperture of only 0.15 of an inch when a power of 16½ was used. In the case of the one-inch telescope above referred to, the loss of light by absorption and reflection at the surfaces of the lenses seem to be about balanced by the increase of contrast with the background, due to the power employed.

Let us suppose that α^2 Centauri were removed to a thousand times its present distance, then, neglecting the absorption of light in travelling through space, it would appear as a star of the sixteenth magnitude, and would only just be visible with a telescope of 25.12 inches aperture; and if it were removed to 1,585 times its present distance, it would shine as a star of the seventeenth magnitude of the photometric scale, and would only just be visible in a telescope of 39.81 inches aperture. That is, it would not be visible in the great Lick 36-inch refractor.

These calculations are based on the assumption that there is no absorption of light in passing through great distances of space, and also on the assumption that there is no loss of light in passing through such thick lenses. The thickness of the object-glass of the Washington 26-inch refractor at its centre is nearly three inches; thus, the flint glass lens is there 0.96 of an inch thick, while the crown glass lens is 1.88 inches thick at its centre. Such a thickness more than halves the intensity of the emergent pencil; and the loss of light by absorption in passing through the glass near the centre of the Lick object-glass must be considerable. Exact measures of the absorption of light by such great lenses would be of much interest. We may, however, probably assume with some confidence, that if α^2 Centauri were removed to twelve hundred times its present distance it would not be visible in the Lick telescope, even though there were no absorption of light in space; and α^2 Centauri is probably larger and brighter than our sun. (Assuming, with Mr. Gore, a period of 77 years for this binary, and a parallax of .75 of a second, the sum of the masses of the components will be 2.14 times the mass of the sun.)

Stars smaller than our sun would be lost to sight at smaller distances. Consequently the Milky Way must either be nearer to us than a thousand times the distance of

[1] A. C. Ranyard, in Knowledge for August.

α Centauri, or the smallest stars visible in it with a telescope as large as the Washington 26-inch refractor must be larger than our sun, a supposition at which the mind rebels when we remember the vast size this would imply for the larger stars evidently involved in or associated with the Milky Way. For example, in the Pleiades group there are observable with the eye at the telescope a range of some thirteen magnitudes of the photometric scale, which, translated into ordinary language, means that the larger stars of the cluster give more than a hundred and fifty thousand times as much light as the smaller stars of the cluster.

In the photographs of the Pleiades cluster we have evidence of a range of at least fifteen magnitudes, which means that the larger stars give a million times as much light as the smaller stars, and in the photograph of the coal-sack region of the Milky Way there is evidence of a still greater range of magnitudes. The star α Crucis, which is of 1.3 magnitude, is evidently associated with a dense cluster of small stars, branches from which can be traced far across the coal-sack region, and extending to a considerable distance over the Milky Way or into the Milky Way to the north of α Crucis. We seem to have in this instance evidence of a range of at least seventeen magnitudes. α Crucis is a double star with components about five seconds apart, and there are several small companions that have been observed in the telescope. In the glass photograph by Mr. Russell the spurious disk of the large star is, when examined with a magnifier, seen to contain several small stars forming a cluster about the large one. Indeed, some seven or eight of these small stars may be recognized with a magnifying-glass on the edge of the spurious disc of the large star.

Though the mind may at first be staggered by the conception of stars giving a million times as much light as our sun, we are not in a position to deny the existence of such vast sun-like bodies. Indeed those who accept the nebular hypothesis as giving the most probable explanation of the origin, or rather of the birth, of the planets of the solar system, must be prepared to believe that there was a time when the sun had a diameter as large, or nearly as large, as the diameter of the orbit of Neptune. If before these more than geologic ages of radiation into space the surface or photosphere of the solar mass did not shine as brightly as it shines now, it must, at least, have been a nebula with a very definite surface, which, as seen from a distance a hundred times as great as that of α Centauri would have presented a disc nearly half a second in diameter. No disc has at present been observed to any star; we may therefore feel some confidence that there is no such vast sun-like body within a distance from us equal to fifty times the distance of α Centauri.

In the forthcoming part of the "Old and New Astronomy," I have shown reason to believe that there is evidence of absorption of light in space, and that we can, from the numbers of the stars of the various magnitudes, make a rough minimum estimate as to the amount of absorption of light in space, due either to a want of perfect elasticity in the light-transmitting ether, or to dark bodies cutting out or obliterating the light in its passage through space. This greatly reduces our idea of the magnitude of the region we can explore with the telescope and with the camera, — α Centauri would probably be lost to the Lick telescope if it were removed to three hundred times its present distance,— and it also greatly reduces our idea of the distance of the small stars of the Milky Way, and of the scale of the galactic system as well as of the nebular system and of the system of clusters, red stars, and bright line stars which are so evidently associated with it.

It is not so very long ago that it was generally taught that the nebulæ were galaxies of stars more or less similar to the Milky Way that surrounds us, but so inconceivably remote as to appear when observed with the largest telescopes like small spots in the heavens. This theory suited the popular taste, and died hard. It involved the assumption that man could explore with the instruments at his disposal a space so immense that the interstellar spaces which we can just measure or guess at, are dwarfed into points beside the distance from which light travels to us.

The theory should have been disposed of by the observations of Sir William Herschel, who noted that many nebulæ are evidently associated with stars, and observed that the smaller nebulæ were distributed over the heavens in a manner which shows an intimate connection between them and the brighter stars. He noted that the nebulæ in the northern heavens were clustered in the pole of the Milky Way, and descended like a canopy on all sides, leaving a dark space or channel separating the nebulous region from the rich stellar region of the Milky Way. Sir William Herschel also fully satisfied himself that "there were nebulosities which are not of a starry nature," and from his observations of diffused nebulæ he formed his well-known hypothesis of a diffused luminous fluid which, by its eventual aggregation, produced stars. But he did not proceed to the legitimate deduction from his observations as to the general distribution of nebulæ, viz., that nebulæ which are arranged so symmetrically with respect to the stars must belong to the stellar system, and therefore cannot be assumed to lie at immense distances compared with the distance of the Milky Way stars.

Sir John Herschel extended the observations of his father to the southern heavens, and showed that there was a similar clustering of the smaller nebulæ on the southern side of the Milky Way, and a similar intimate connection between the distribution of stars and the distribution of nebulæ in the southern hemisphere (Cape Observations, p. 134); but it was not until 1858 that the obvious conclusion from these observations was drawn by Mr. Herbert Spencer in a remarkable paper on "The Nebular Hypothesis," published in the *Westminster Review*. He remarked, "If there were but one nebula, it would be a curious coincidence were this one nebula so placed in the distant regions of space as to agree in direction with a starless spot in our own siderial system. If there were but two nebulæ, and both were so placed, the coincidence would be excessively strange; what then shall we say on finding that there are thousands of nebulæ so placed? Shall we believe that in thousands of cases these far-removed galaxies happen to agree in their visible positions with the thin places in our own galaxy? Such a belief is impossible."

Mr. Herbert Spencer's paper was not illustrated by charts, and the force of his reasoning was not generally perceived till some ten years afterwards, when Professor Cleveland Abbé drew attention in the Monthly Notices of the Royal Astronomical Society for May, 1867, to the intimate connection between the distribution of nebulæ in space and stars; and Mr. Proctor, in 1869, constructed some charts on an equi-surface projection, which graphically put his readers in possession of the facts and carried conviction to all who read his remarks.

The theory that the nebulæ were distinct galaxies involved the assumption that light can reach us from regions many thousand times more remote than the stream of stars which compose our own galaxy; and it also involved the assumption that the matter of the universe is aggregated into clusters, separated by immense barren spaces, in which we must assume that there are very few luminous stars, and but few dark stars which would absorb light, as well as comparatively very little opaque matter distributed as meteors are distributed in the region of space we are familiar with.

We have evidence that the greater part of the lucid stars belong to the galactic system, but the large proper motion of some stars, taken in conjunction with their small parallax, affords evidence, as Professor Simon Newcomb has pointed out, that they will in time pass away from our galaxy. (Professor Newcomb has shown in his "Popular Astronomy" that, making the most liberal assumptions as to the number and masses of the stars of our galactic system, the highest speed which a body could attain if it fell from an infinite distance through such a stellar system would be twenty-five miles a second, a velocity which is certainly smaller than that of many stars.) The regions outside our galaxy cannot, therefore, be absolutely barren, but however sparsely luminous stars are distributed through space, if there were no absorption of light in its passage through the ether, and no opaque bodies to blot out the light of distant stars, it would be impossible, as Olbers long ago pointed out, to draw a line in any direction which would not in an infinite universe pass through some luminous star, and the whole heavens ought to shine with the average brightness of such stars.

That the heavens are comparatively dark may, therefore, be taken as proof either that the light-transmitting ether is not perfectly elastic, or that there are numerous dark bodies in space that blot out the light which we should otherwise derive from the more distant parts of the universe.

NOTES AND NEWS.

THANKS to new sanitary measures in England, says the *Medical Record*, there has been a diminution of more than thirty per cent in the death-rate from consumption since 1861.

— In a recent number of the *Archives of Surgery*, Mr. Jonathan Hutchinson says that he has for many years been in the habit of forbidding fruit to all patients who suffer from tendency to gout. In every instance in which a total abstainer of long standing has come under his observation for any affection related to gout, he has found on inquiry that the sufferer was a liberal fruit eater. Fruits are, of course, by no means all equally deleterious; cooked fruits, especially if eaten hot with added sugar, are the most injurious, the addition of cane-sugar to grape-sugar adds much to the risk of disagreement. Fruit eaten raw and without the addition of sugar would appear to be comparatively safe. Natural instinct and dietetic tastes have already led the way in this direction; few wine-drinkers take fruit or sweets to any extent, and Mr. Hutchinson suggests as a dietetic law that alcohol and fruit-sugar ought never to be taken together; and he believes that the children of those who in former generations have established a gouty constitution may, though themselves water-drinkers, excite gout by the use of fruit and sugar.

— A statement, by State Geologist Arthur Winslow, of the operations of the Missouri geological survey during the month of July shows that work on iron ores was begun during the latter part of the month, and inspections were made in Callaway and Wayne Counties. Zinc and lead deposits have been examined and reported upon in Newton, McDonald, Barry, and Lawrence Counties. The occurrence and distribution of coal have been studied in Carroll, Chariton, Howard, Monroe, Buchanan, Nodaway, Gentry, and Davis Counties. Detailed mapping has been prosecuted in Macon, Madison, Ste. Francois, and Ste. Genevieve Counties, and about 160 square miles have been covered. In the laboratory the analysis of some twenty-two samples of mineral waters have been completed. The work on paleontology and general stratigraphy has been actively prosecuted in the north-eastern part of the State along and adjacent to the Missouri River. The quaternary formations in Buchanan, Jackson, Saline, and adjacent counties have received special study. A work recently started, looking towards obtaining an estimate of the total amount and value of the mineral products of the State up to the present date, has been given special attention during the past month, and is now well advanced. In the office, Bulletin No. 5 will be ready for distribution soon. It consists of a paper on the age and origin of the crystalline rocks of Missouri and one on the clays and building stones of certain counties tributary to Kansas City. Considerable progress has been made in the preparation of Bulletin No. 6, and in the draughting of maps for publication. The granites and porphyries in Madison County have further been studied and their areas mapped, and the distribution of the geological formations have been outlined in a part of Greene County. Inspections of building stones and of clay deposits have been made in Stone, Jefferson, Ste. Genevieve, Mississippi, Stoddard, Scott, Cape Girardeau, Madison, Iron, Wayne, Butler, Greene, Webster, Phelps, and Crawford Counties. In connection with the various works above referred to, many photographs have been taken illustrating the occurrences of minerals and other geological phenomena in the State, and a large number of specimens have been collected for purposes of study, test, and exhibit.

— A correspondent of the *American Field*, writing from Sidney, O., says: "A friend of mine, a careful observer, recently related an occurrence he witnessed some years ago. While watching fish through clear ice in shallow water, he saw a muskrat moving about on the bottom, apparently feeding. Presently the animal stopped and emitted the air in his lungs, which came up in small bubbles to the under surface of the ice. He then came up, put his nose to the large bubble and rebreathed the air. This may be old, but it was new to me, and may be to others"

— In a paper on the density of weak aqueous solutions of certain sulphates, read before the Royal Society of Canada on May 28, 1890, Professor J. G. MacGregor of Dalhousie College, Halifax, gives the following as the general results of his study of the subject: (1) In addition to magnesium, zinc, and copper sulphates, already known to form weak aqueous solutions having a volume less than their constituent water would have in a free state, aluminum, cadmium (possibly), cobalt, and nickel sulphates are found to exhibit the same peculiarity; (2) the formation of such solutions is not a property of the sulphates generally; (3) neither is it a property of all the metals of any one of the groups into which the metals are divided by chemists; (4) the formation of such solutions does not seem to depend upon the amount of the water of crystallization of a salt.

— From a series of observations on woodpeckers, made in the region of Mount Chocorua, New Hampshire, Mr. Frank Bolles, in a communication to the *Auk* for July, draws the following conclusions: that the yellow-bellied woodpecker is in the habit for successive years of drilling the canoe birch, red maple, red oak, white ash, and probably other trees, for the purpose of taking from them the elaborated sap and in some cases parts of the cambium layer; that the birds consume the sap in large quantities for its own sake and not for the insect matter which such sap may chance occasionally to contain; that the sap attracts many insects of various species, a few of which form a considerable part of the food of this bird, but whose capture does not occupy its time to any thing like the extent to which sap drinking occupies it; that different families of these woodpeckers occupy different "orchards," such families consisting of a male, female, and from one to four or five young birds; that the "orchards" consist of several trees usually only a few rods apart, and that these trees are regularly and constantly visited from sunrise until long after sunset, not only by the woodpeckers themselves, but by numerous parasitical humming-birds, which are sometimes unmolested but probably quite as often repelled; that the forest trees attacked by them generally die, possibly in the second or third year of use;

that the total damage done by them is too insignificant to justify their persecution in well-wooded regions.

— London *Iron* says: "A novelty in boat building is the tiny steamer just completed for the Frankfort Electrical Exhibition by Messrs. Escher, Wyss, & Co. of Zürich, and which made a successful trial trip on the Limmat the other day. It is constructed entirely of aluminum, even to the engines and screw propeller, and is the first vessel that has been built of the light, ductile, silver-white 'metal of the future.' The lilliputian bark is twenty feet long and five feet wide, and is driven by a two horse-power naphtha motor. As this compact style of engine, when, as is usually the case, it is wrought out of iron, is already considered one of the lightest on the market, the further advantage gained in this respect when the motor is constructed of aluminum is obvious."

— That severe mental distress or fright sometimes produces physical disease, and occasionally even death, is an admitted fact, according to the *Lancet*, although the way in which it acts has hitherto been but little studied. In order in some measure to supply the deficiency in our knowledge regarding this matter, Dr. G. Bassi has recently made a number of observations on animals which apparently died in consequence of capture. Birds, moles, and a dog which had succumbed to conditions believed by Dr. Bassi to resemble those known among human beings as acute nostálgia and "a broken heart," were examined post mortem. Generally there was hyperæmia, sometimes associated with capillary hemorrhages of the abdominal organs, more especially of the liver, also fatty and granular degeneration of their elements, and sometimes bile was found in the stomach with or without a catarrhal condition. The clinical symptoms were at first those of excitement, especially in the birds, these being followed by depression and persistent anorexia. The theory suggested by Dr. Bassi is that the nervous disturbance interferes with the due nutrition of the tissues in such a way as to give rise to the formation of toxic substances, — probably ptomaines, — which then set up acute degeneration of the parenchymatous elements similar to that which occurs in consequence of the action of certain poisonous substances, such as phosphorus, or to that met with in some infectious diseases. In support of this view, he points out that Schule has found parenchymatous degeneration in persons dead from acute delirium, and that Zenker found hemorrhages in the pancreas in persons who had died suddenly. He refers also to some well-known facts concerning negroes in a state of slavery, and to the occasional occurrence of jaundice after fright. He hopes that these hints may induce medical officers of prisons and others to study both clinically and anatomically this by no means uninteresting or unimportant subject.

— Additional experiments and observations upon ammonite seem to confirm the first opinions regarding its safely and its power. Direct application of heat or concussion fail to explode it. Atmospheric changes exert no influence upon it whatever. It has been tried in a large number of the most dangerous coal mines in England without igniting the gases which were known to be present at the time. A mixture of coal-gas and coal-dust was not exploded by it, even when no more than two inches of tamping was used. The safety tests have been so thorough and satisfactory that the railroads of the United Kingdom accept ammonite as freight without the usual restrictions placed upon explosives, and it even meets the requirements of Sir George Elliot for perfect security, which is saying a great deal. According to the *Railroad Gazette*, ammonite consists of an intimate mixture of 81½ per cent of ammonium nitrate and 18½ per cent of mono-nitro-naphthalene. The manufacture is extremely simple and practically unattended with danger. Being free from chlorates it is not liable to decomposition or spontaneous combustion. Having no picric acid or chlorinated derivatives of hydro-carbons in its constitution it yields no injurious or corrosive fumes among its products of combustion. It is put up for use in lead-foil cartridges and exploded with a detonator. Tests made in England on July 9 showed that it possesses great strength, a projectile of 29 pounds weight being thrown from a mortar elevated forty-five degrees to a distance of 320 feet from the muzzle by a five-gram charge, as against 289 feet by a similar charge of No. 1 dynamite, and 136 feet by an equal weight of gunpowder. Notwithstanding this, ammonite has as yet only been proved of value in comparatively soft material. Experiments are in progress, however, to secure if possible a high efficiency with this explosive in hard rock work. While the security claimed for ammonite is highly encouraging it should be remembered that it is commonly "the unexpected that happens." It would seem that ammonite possessed a special virtue in the absolute safety of its separate ingredients, and in the great ease of its manufacture, which would enable it to be made upon the spot where it was needed, by any one having even a meagre knowledge of chemistry, and with a very inexpensive plant.

—The Supreme Council of Hygiene of Austria has been engaged in discussing the advantages of erect as compared with slanting writing, and the official report of Drs. von Reuss and Lorenz points strongly in favor of the former. According to the London *Educational Times*, they point out that the direction of the written characters has a marked influence on the position of the body. In "straight" writing the scholar faces his work, and is spared the twist of the body and neck which is always observable in those who write slantwise, and one common cause of spinal curvature is thus obviated. The erect method is, therefore, expressly recommended for use in schools in preference to the ordinary sloping lines.

— M. Constantin Miculesco has communicated to the Paris Académie des Sciences a note on a new determination of the mechanical equivalent of heat. According to *Engineering*, the method used was in principle the same as that of Joule, viz., the production of heat in a calorimeter by means of friction. In Joule's experiments, however, the total work done was small, and hence a long time was required to obtain a sensible heating of the calorimeter, and various difficult corrections had to be made. To avoid this, M. Miculesco made use of a fairly powerful electromotor to supply the work which was to be turned into heat. The apparatus consisted of a one horse-power Gramme electromotor, carried on a frame suspended on knife edges, the shaft of the motor being central with the line of these supports. A calorimeter consisting of two concentric cylinders was mounted on a separate frame, so that the axes of the cylinders coincided with the centre line of the motor shaft. This shaft was coupled, by a flexible connection, to one carrying paddles, which it caused to rotate in the water in the cylinder. Under these circumstances the frame carrying the motor tended to swing on its knife-edges so as to balance the torque on the motor shaft, and by correcting this tendency by carefully adding weights, this torque could be measured with great accuracy. The result obtained was $J=777.7$ foot pounds.

— The United States Coast and Geodetic Survey Office at Washington has received a report from Assistant J. E. McGrath of that service, dated June 20, 1891, Camp Davidson, Upper Yukon River, near eastern boundary of Alaska, in which he states that the health of the party has been excellent, and the work at that station is practically completed; and that as soon as the necessary solar observations for rating the chronometer could be obtained, they would leave for St. Michael's. The trip will be made in open boats, as certain magnetic observations were to be made at Fort Yukon, obliging the party to stop there. Mr. McGrath expects to reach St. Michael's by Aug. 25, and in time to come south on the revenue cutter "Bear." In his report Mr. McGrath states that the astronomical observations have been very much delayed by cloudiness and rain. Meteorological observations have been continuously made three times a day. The average monthly temperature since December shows an increase of a few degrees over the same months of the preceding year. The lowest minimum temperature noted was on Jan. 16, on which date the lowest temperature read was $-60.5°$ F. The Yukon River opened nine days later this year than in 1890. Mr. McGrath speaks in the highest terms of the diligent and faithful conduct of all the members of his party, mentioning by name his assistants Mr. Davis and Dr. Kingsbury. The latter gentleman had at the date of the report left camp for home, carrying with him the duplicate records of the party, it being deemed safer to have them sent ahead of the originals, to avoid possible loss of both sets. Mail has already been received from Dr. Kingsbury from San Francisco.

— Particulars of the observatory which it is proposed to erect on Mont Blanc at the very summit are given in the *Neue Züricher Zeitung*, from which *Engineering* quotes as follows. The idea originated with M. Janssen, who stayed on the mountain some time last summer for the purpose of making meteorological observations. In conjunction with M. Eiffel, and with the support of M. Bischoffsheim, Prince Roland Bonaparte, and Baron Alfred de Rothschild, he has now elaborated the plan of an observatory to be entirely of iron, and to have a length of eighty-five feet and a breadth of twenty feet. The iron roof is to have a spherical form. The erection of such a building on the highest point of Mont Blanc naturally involves preliminary studies, with which a Zürich engineer experienced in works on high mountains has been charged by M. Eiffel and M. Janssen. In the first place, it is necessary that a firm foundation should be found for the supports of the building on the rock of the mountain. For this purpose a horizontal gallery is to be driven through the ice of the highest glacier until rock is met with, and by means of this gallery the formation and position of the rock buried beneath the ice and snow are to be ascertained and examined. If once this has been accurately determined, a structure is to be designed which will give to the observatory a firm hold by iron pillars founded in the rock. The question of how the heavy materials are to be moved to the top of the mountain does not appear to give much concern, but more is thought of the work of surveying, which was to have been commenced this month. Should the surveys prove the practicability of the plan, it is intended to proceed with the erection in September.

— In connection with an item from *Nature* on copepoda in these columns last week, the following communication to the same paper, from Mr. I. C. Thompson of Liverpool will be of interest: "Professor Herdman's practical demonstration at the North Cape confirms a theory I have long held, that the copepoda, which abound in every ocean, sea, and lake, might be largely and advantageously made available for human food. It is well known that the species *Calanus finmarchicus*, so abundant in our northern seas, forms the chief food of the Greenland whale. Our own immediate coasts abound in this and other equally edible species. During a recent dredging cruise round the Isle of Man, each pull of the tow-net contained thousands of another and larger species of copepod, *Anomalocera patersonii;* and Dr. John Murray has found that a still larger species, *Euchæta norvegica*, is plentiful in the lower depths of several Scotch lochs. A number of finely-meshed trawls, used off the west coast of Ireland, would, I am convinced, furnish excellent food for starving multitudes in time of need. *A propos* of the distribution of copepoda, my attention was called a few days ago by the Mayor of Bootle to the filter-beds of the town salt-water baths, which he said were swarming with *Entomostraca*. The water is supplied direct from the river, and examination showed the presence of copepoda in enormous quantities, the bulk of them being *Eurytemora hirundo*, a species only once before taken in Britain, and then in near proximity to Bootle. Probably other filter-beds are equally prolific, and may prove valuable hunting-grounds, the copepoda undoubtedly acting as scavengers in keeping the water pure from putrefaction."

— It seems as if the introduction of large engineering views may soon produce a very marked effect upon the future of Egypt. Mr. Willcocks, one of the Inspectors of Irrigation, has communicated a letter to the London *Times*, in which he says that the summer supply of the Nile is lamentably deficient for the existing cotton and sugar-cane crops of Egypt, so that all extensions of these valuable crops are out of the question under existing conditions. The Nile Valley in Nubia is eminently suited for storage of water, but up to the present all projects for storing the muddy flood waters of the Nile below the junctions of the Blue Nile and the Atbara have been condemned, as the construction of solid dams would have resulted in the silting up of the reservoirs themselves. This difficulty has disappeared now that it has been discovered that open dams can be constructed that will allow the muddy flood waters to flow through, and store the clear winter supply for use in summer. The construction of these dams has been rendered possible by the great success of Stoney's patent roller-gates, which can be worked under heads of 70 feet of water on a scale sufficient to pass the full flood supply of the Nile. At any time now Egypt can construct a reservoir in its own territory by building an open dam at the head of the Assouan cataract. If, however, Egypt were allowed to occupy the Nile Valley as far as Dongola, the reach of the river above the Wady Halfa cataract would provide the necessary reservoir, and the Philæ immersion difficulty would be at an end. So far the summer supply needed for Egypt proper. If the Soudan itself is to be developed, it will only be necessary to construct solid dams at the heads of the Ripon Falls and Fola Rapids, and thus secure the Victoria and Albert Nyanza Lakes as magnificent reservoirs. These reservoirs would not only secure Egypt and the Soudan from drought, but would also, if provided with open dams, secure Egypt from excessive floods. The White Nile as it leaves the two lakes is a clear stream, so that the silting up of the reservoir would be out of the question, leaving alone their great size.

— The success of the University Extension scheme in this country, says the London *Educational Times*, has attracted much attention in educational circles in France, and the ministry of education has decided to have the subject investigated on the spot. Accordingly, M. de Varigny, a member of the University of Paris, has been delegated to study the working of the scheme during the present summer and autumn in England and Scotland, and to make a report upon it.

— Professor Langley, the director of the Smithsonian Institution, is now in England. *A propos* of his recent researches on mechanical flight, *Nature* learns that Mr. Maxim is building a "flying machine," with which a series of experiments is contemplated. It is now being constructed at Crayford, and is nearly ready for launching. It will be propelled by a light screw making twenty-five hundred revolutions a minute. The motive power (it is reported) is supplied by a petroleum condensing engine weighing eighteen hundred pounds, and capable of raising a forty thousand pound load. The real suspending power will lie in an enormous kite measuring one hundred and ten feet long and forty feet wide.

— Mr. Edward Standford has published a pamphlet on "The Spread of Influenza: its Supposed Relations to Atmospheric Conditions," by the Hon. R. Russell. The following, says *Nature*, are some of the author's conclusions as to the conditions which give rise to influenza, and permit it to be spread. Influenza is a disease caused by exceedingly minute microbes, arising from extensive areas of marsh or sodden land in Central Asia, China, or Siberia. The minuteness of the microbes or their spores is shown by their easy transmissibility, and the large number of persons capable of being infected by a single case in a large room, most persons probably requiring many virulent organisms to be inhaled in a short time before the resistant power of the blood is overcome. This microbe, like that of cholera, multiplies with great rapidity, and probably soon produces sufficient poison to terminate its career in the body, but not before multitudes of spores or microbes have been given off by the breath. Given the original conditions of rainfall, soil, and high temperature, the certain result is the development of inconceivable multitudes of microbes and spores. One species of these is capable of planting itself and living in the tissue and blood of man, of which the temperature is probably near that to which it has been accustomed under the summer sun in wet and drying ground. The somewhat rare and occasional visitations of influenza may be due to at least two or three causes — first, the occurrence of unusual rainfall and favorable summers; second, the prevalence of air-currents from the drying area towards inhabited places; third, adequate communication between these infected places and the towns of Russia, whence progress is rapid towards western Europe. The wind has no influence that can be verified in the transportation of influenza. As for the means of prevention, Mr. Russell thinks that measures of disinfection and isolation of the earliest cases, and rules at ports and landing places similar to those employed against cholera, would probably prove of the greatest service. Inland, every locality should isolate and disinfect its first cases.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

JUGGLERY.[1]

RECENTLY I met with a certain observation the source of which, to my regret, I failed to note. I therefore take the opportunity of appealing to my readers for their kind help in identifying the passage or quotation in question, because it has a scientific bearing of a very obvious nature. The observation was as follows: A writer, in speaking of the fallacies of the senses, described the Hindoo juggler's trick of causing a small plant to grow out of a flower-pot in which, a few moments before, the conjurer had placed some seeds. The pot is covered over or concealed by a blanket, and when the covering is withdrawn the apparently marvellous and instantaneous growth of the seed into a perfect plant is witnessed. Now, the writer in question goes on to state that an amateur photographer had taken a "snap-shot" at the conjurer and his performance, and when the negative was developed no plant could be seen growing in the pot at all. The inference is that the spectators only fancied they saw a plant, and that the success of the trick is due to the juggler making his audience believe they see what does not really exist. In plain language, he is supposed to hypnotize the spectators, and the illusion is to be regarded not as due to his dexterity but to his power of making the spectators believe they see what he wishes them to behold.

Assuming the incident with the camera to be true and of good report, how is the omission of the flower in the pot to be accounted for? If a photograph of the scene had been taken at all, it must necessarily have included all the details within range of the lens, and, as Boucicault makes one of his characters in "The Octoroon" say, "The apparatus doesn't lie." I do not pretend to criticise the statement at all. I am merely anxious to know if any of my readers interested in psychical matters can confer a favor by referring me to the original source of the story. My own recollection is that I casually met with the reference in an American magazine, which I glanced at while waiting for a friend. The name of the magazine and its date (which must be recent, I fancy) have both escaped my recollection.

After thinking over the above incident, one is inclined to be somewhat sceptical of the story as I have related it — although my version, I admit, may not be absolutely correct. A perusal of a paper by Chevalier Hermann, the conjurer, confirms me in my scepticism. He tells us that when he visited India he could find no foundation in actual fact for the marvellous stories of Hindoo jugglery, including the fact of "youths tossing balls of twine in the air and climbing up on them out of sight." What Herr Hermann did see in India, he tells us, he could have imitated "with little preparation," and that he "would not presume to introduce them upon the stage." This is a decided blow to the reputation of our Indian friends, and after this assertion the tales of fakirs being buried for six weeks, and recovering thereafter, may reasonably be doubted also, although I shall feel interested in hearing from any of my Indian readers accounts of what they have actually seen in the way of startling magic. It will be interesting if I quote what Hermann has to say of the flower-pot trick, which the unknown psychologist has tried to explain on the basis that the conjurer causes his audience to see what does not exist — a startling enough theory, by the way, since it supposes that all sorts and conditions of men looking on could be simultaneously hypnotized.

In Bombay a troupe of jugglers appeared in front of the hotel in which Herr Hermann was staying After a short address, an empty flower-pot was produced. This was filled with earth, which was moistened with water, and into the pot a few mango seeds were dropped. A large piece of cloth was used to cover the pot, which rested upon a tripod of bamboo-sticks. Then followed an address to the audience, and the operator walked slowly round the covered pot, "dexterously allowing his robes to envelop it at each turn," while the other members of the troupe chanted a kind of incantation. After some three minutes occupied in this performance, the incantation ceased, the cloth was removed, and in it was seen growing a mango-tree about three feet in height, the plant having apparently grown after the planting of the seed. This is a bare description of what the Western conjurer saw his Eastern rivals perform, and it sounds very wonderful, no doubt. Hermann's explanation of the trick, however, causes us to repeat the hackneyed expression that "it is not at all startling when you know how it's done." What the Hindoo wizard did was to remove the pot from beneath the cloth — a dexterous proceeding enough, but not a whit more wonderful or clever than things we see done at the Egyptian Hall or at other entertainments of like nature — and to substitute the growing mango, which he carried concealed under his robe. "This," adds Hermann, "he did rather clumsily, while he let the robe rest, as if by accident, over the covered flower-pot previously displayed."

This recital is interesting scientifically, because, as I have said, we hear so much about Indian jugglery and esoteric mysteries, which no science is supposed to be capable of explaining, that one may find some justification for a continued display of scepticism when still more mysterious feats are gravely detailed. I find that the facts about Indian magic and mystery set forth in books in grave, circumstantial array do not always coincide with what actually occurs; hence my appeal to Indian readers of these lines for accounts of things they may have seen in the way of live burials and resuscitations (if such things are still in vogue) and like phenomena.

[1] Dr. Andrew Wilson, in the Illustrated News of the World.

I referred, when I began these jottings, to the idea that the explanation of a trick was to be found in the delusion of the spectator's senses; and this reminds me of a very interesting case which certainly proves to us how a dominant idea may be impressed on the minds not of a few spectators but of thousands, with an utterly futile result when all is said and done. When the Crystal Palace took fire, many years ago, efforts were made to rescue the animals from the menagerie, which was lodged in the burning part. As the fire progressed, a large monkey was seen by the spectators to appear on the roof and to hold on to some pinnacle or other, apparently writhing in terror at its impending incineration. Desperate attempts to reach the unfortunate animal were made. The crowd was breathless with anxiety. Every movement of the rescuers was watched with agonizing interest. At last the ape was reached, and was found to be — a piece of canvas, which had apparently been detached from the building, and which, clinging to some post or pole, had impressed the crowd, by its flapping, with the idea that it was a big monkey writhing with fear and agony. This, I believe, is a well-founded fact. It proves to the full, of course, that, given an idea, supported by a fair show of demonstration, such a thought is certain to become dominant and overruling in the minds of many men. How far this principle may serve to explain many another delusion of human life, I leave my readers to judge.

LECTURE EXPERIMENTS ILLUSTRATING PROPERTIES OF SALINE SOLUTIONS.[1]

(1) In a paper printed in the last volume of this institute's proceedings (Proc. N. S. Inst. Nat. Sci., vii., 368) I pointed out that, according to Kohlrausch's observations, sufficiently dilute solutions of sodium hydroxide have volumes which are less than the volumes which their solvent water would have in the free state, one gram of a solution containing about six per cent of the hydroxide, having a volume 0.0045 of a cubic centimetre less than the water contains. Several other substances are known which exhibit the phenomenon of contraction on solution, in a similarly marked manner, but none which exhibit it to such an extent. This hydroxide, therefore, affords the best means of exhibiting the phenomenon of contraction by a lecture experiment.

The simplest mode of conducting the experiment is to pass the powdered caustic soda, little by little, down a glass tube forming a prolongation of the neck of a large bottle, the bottle and part of the tube having been first filled with distilled (or, indeed, undistilled) water. The substance is quickly dissolved by the water, the strong solution thus formed sinks and mixes with the water below, and the change of volume of the liquid is indicated by the change of height of the column of liquid in the tube. In order that the experiment may be made quickly, the powder must not be allowed to form a cake in the tube where it meets the water. To avoid this, a tube of about seven or eight millimetres in diameter must be used. It should be seven inches in length, and should have the upper end opened out to a funnel shape, to facilitate the introduction of the powder. The tube being necessarily of large bore, the bottle must also be large, so that a small change of volume may be indicated by a comparatively large elevation or depression in the tube.

The hydroxide should be in the form of a powder, not only that its solution may be accomplished quickly, but also because the solution formed must be dilute in order to secure a depression of the liquid in the tube. If it be not powdered, the substance falls to the bottom and forms a strong solution there, which only gradually diffuses into the water above. Even with a fine powder, however, a comparatively strong solution is formed at the bottom. Hence I have found it advisable to catch the powder in a wire gauze cage, attached by sealing-wax to the inner end of the rubber stopper which carries the tube, and to hasten the mixture of the strong solution, formed in the tube and cage, with the water, by diverting the downward currents of the strong solution towards the sides of the bottle by means of a plate of glass hanging horizontally below the cage. If a wide-mouthed bottle be used, a stirrer may be introduced through the stopper, but leakage is thereby rendered more probable.

The full amount of the contraction indicated by Kohlrausch's observations cannot, of course, be shown. For (*a*) the powdered caustic soda already contains a considerable quantity of water; (*b*) the solution of the substance is attended by a development of heat involving a rise of the liquid in the tube; (*c*) the powder carries air with it into the water, which must increase the volume whether it dissolves or remains suspended, for in the latter case, if a quick effect is desired, there is not sufficient time for it to escape up the tube; and (*d*) whatever precautions may be taken to secure a uniform solution throughout the bottle, it cannot be at all completely secured in the time at disposal. But notwithstanding these difficulties, the experiment is a very striking one, especially if projected by a lantern on a screen. As the powdered caustic soda is passed down the tube, little by little, the liquid is seen to dissolve it without any increase in bulk, and if the substance does not already contain too much water, with an actual diminution in bulk, the level of the liquid sinking in the tube. If the powder be added in large quantity, there is a sudden rise of liquid in the tube, followed by a gradual shrinkage, which continues until the level of the liquid is lower than at the outset. The amount of the depression of the liquid in the tube is sometimes small, depending apparently upon the amount of water which the powdered caustic soda has already absorbed. The substance should not be too finely powdered, as in that case it is likely both to have taken up a considerable quantity of water and to carry down with it a considerable quantity of air. The experiment requires only a few minutes to perform.

(2) The working hypothesis which I use when thinking of the phenomena of solution, has led me to the conclusion that elevation of the temperature of a solution will have, if not identically, at any rate in a general way, the same effect on its selective absorption of light, and therefore on its color, as increase in its concentration. All the experimental evidence of which I can find any record bears out this conclusion. But, whether it holds generally or not, it may be shown, by a striking lecture experiment, to hold in the case of two salts, the chlorides of cobalt ($CoCl_2$) and of iron ($FeCl_6$). To do so, make a trough, for projection with a lantern, having thin glass sides, about the size of a lantern-slide, the glass sides being one or two millimetres from one another. It may readily be made by cutting a U-shaped piece from a sheet of India-rubber, and cementing the glass plates to its opposite sides. Half fill the trough with a saturated solution of either salt, and fill up with a weak solution. If cobalt chloride have been used, the solution in the lower part of the trough will at ordinary temperatures be of a purplish blue, that in the upper part red; and it will be obvious that increase of the concentration of this salt involves increase of blueness in the transmitted light. If, now, a Bunsen flame be played carefully over one side of the trough, the solutions rapidly rise in temperature, and both are seen to increase in blueness, the saturated solution becoming deep blue and the weak solution purplish red. If the iron chloride have been used, the solution in the lower part of the trough, before heating, is seen to be of a deep orange color, that in the upper part yellow; and it is obvious that increase in the concentration of this salt involves increase in redness. If, now, the flame be applied as before, the yellow solution is at once seen to become orange and the orange solution red. Owing to the narrowness of the trough and the thinness of its glass sides, sufficient heating to produce a marked change of color occupies only half a minute or so. The same trough may of course be used to project the absorption spectra of these solutions on the screen. If the slit be covered half by the one solution and half by the other, both absorption spectra may be seen at once, side by side, and the gradual variation of the spectra may be watched as the trough is gradually heated.

As a means of showing the variation of the color or absorption

[1] Professor J. G. MacGregor, in Transactions of Nova Scotian Institute of Science, session of 1890–91.

spectrum of a solution with concentration, the above experiment has an obvious defect, viz., that the thickness of the layer of the strong and weak solutions being equal, the numbers of the salt molecules through which any ray of light passes are very different in the two cases. It should therefore be supplemented by showing also the color or the spectrum obtained when the light is passed through a wide trough of the dilute solution, the ratio of the widths of the troughs being the reciprocal of the ratio of the percentages of salt in the two solutions.

(3) Dr. W. W. J. Nichol's observation (Phil. Mag., Ser. 5, xix., 453) that anhydrous sodium sulphate will dissolve in a supersaturated solution of that salt may readily be shown as a lecture experiment by projection. For that purpose place a test tube containing the solution in a trough with glass sides full of water, and focus it on the screen. Then let the anhydrous salt in the form of a fine powder, fall upon the surface of the solution. By taking a pinch of the powder between the thumb and forefinger (both being quite dry), it may be made to fall as a shower of fine particles. These pass into the solution and are seen to move slowly across the screen through the solution, dissolving as they go, in some cases disappearing, and often changing the concentration of the part of the solution through which they have passed, so as to produce obvious refraction effects. Finally, to show that the solution was supersaturated, add a few crystals of the hydrated salt and crystallization at once occurs. The anhydrous salt must be added as a shower of fine powder, as larger pieces may — by taking up water and forming crystals of the hydrated salt before they can dissolve it — give rise to a general crystallization of the solution.

(4) The peculiarity of the solubility in water of such substances as aniline, carbolic acid, etc., observed by Alexejew (Wied. Ann. Bd. XXVIII., 305), may readily be shown on the screen, by using carbolic acid, whose critical temperature (the temperature above which it and water are mutually infinitely soluble) is about 69° C. For this purpose, pour some of the acid into a long test-tube, of about twelve or fifteen millimetres in diameter, and add water. The water will lie in a layer above the acid. Support the test-tube by a clip grasping at the top, and focus on the screen. The line of demarcation between the two liquids will be evident. Now mix the liquids by stirring, and the whole becomes cloudy. Let the tube stand, and the liquid separates again into two layers, having different depths from those they had before, both being now solutions. As this process requires considerable time, the stirring may have been done beforehand. Next surround the test-tube by a beaker of boiling water, passing it upwards from below, and stir the liquids with a hot glass rod. A slight cloudiness appears, but the liquid quickly clears and is seen to have become homogeneous throughout, the line of demarcation having disappeared. If now the beaker of hot water be removed, and one of cold water be substituted for it, the liquid becomes cloudy, a strong solution separating out everywhere, and the little spherical masses of strong solution sinking and coalescing as they sink, to form larger spheres. After a time the liquid is seen to have again become separated into two layers. If the necessary time is not available, the separation into layers may be obtained very quickly by removing the beaker of cold water and again applying the hot bath, which, raising the temperature, stops the separating out of the strong solution and re-dissolves it in the surrounding weaker solution, thus producing a comparatively strong solution in the lower part of the tube and a comparatively weak one in the upper part. The experiment requires but a few minutes and is both striking and instructive.

SOME DISEASES OF LETTUCE AND CUCUMBERS.

DURING the past winter and spring James Ellis Humphrey, professor of vegetable physiology at the Massachusetts Agricultural Experiment Station, has been engaged in the study of certain diseases of lettuce and of cucumbers, cultivated under glass. The investigation of some of these is sufficiently advanced to justify the following preliminary announcement, given in Bulletin No. 40 of the station mentioned.

The rotting of lettuce has been a source of much loss to gardeners who cultivate that plant as a winter crop, but its cause, and, therefore, proper preventive measures, have not been known. It usually appears first just above the surface of the soil at the attachment of the lower leaves to the stem, and then spreads to the centre of the head, causing the stem and the bases of the lower leaves, and later the whole of the tender inner leaves, to become decomposed into a slimy mass. The larger leaves being thus cut off from the stem by decay at their bases usually dry up; and there appears after a time, on the remains of the plant, if left undisturbed, the erect, spore-bearing threads of one of the imperfect fungus forms known by the name *Botrytis* or *Polyactis*. The vegetative threads of this fungus are to be found in the decaying tissues of the host in the early stages of the trouble, and no other fungus has ever been observed in connection with it. The professor's observations make it practically certain that the disease is due to the fungus-form mentioned, and this view is supported by the fact that similar forms are known to produce similar diseases in some other plants. This fungus appears to be able to develop also a saprophyte on old lettuce-leaves and other vegetable refuse, and may thus survive a long interval between two crops of lettuce, resuming its parasitic habits when the opportunity is afforded.

From what has been said, it is evident that careful and thorough treatment is essential to the control of the disease in question; and the nature of the crop limits this treatment to the removal of all sources of infection. All affected lettuce plants should be at once removed wholly from the house and destroyed by burning. For this purpose the boiler furnace is conveniently at hand. All dead leaves or other refuse should be often scrupulously cleaned up and burned, so that no breeding places may be left for the fungus. A house which has been very badly infested by the disease should be thoroughly cleaned, whitewashed, or painted, and supplied with fresh soil before a new season's operations are begun; and one may then expect, with the observance of the above described hygienic precautions, to be able to enjoy comparative freedom from loss from this cause.

The powdery mildew of the cucumber is due to the presence of a fungus which has been long known, but which has not been heretofore reported as occurring in America, so far as can be learned. It has been received during the past season, on leaves of greenhouse cucumbers, from Dr. Jabez Fisher of Fitchburg and from Professor L. H. Bailey of Cornell University. The fungus, as has been said, attacks the leaves, on whose upper surfaces it forms at first rounded spots, which appear like blotches of a white powder. These spots gradually enlarge and become confluent until the leaf is practically covered. Those parts of the leaf which are attacked soon turn yellow, and finally become dead and dry. Under favorable conditions the disease spreads quite rapidly and is very destructive.

The fungus which causes the trouble is known as *Oidium erysiphoides* Fries, var. *Cucurbitarum*, and is the *conidial* or summer spore stage of one of the fungi known as "powdery mildews." It is impossible to say certainly to which of the perfect or winter spore forms of the group it belongs.

It has been found by Professor Bailey and by Dr. Fisher that the fungus may be kept in check by frequent spraying with a solution of sulphide of potassium (liver of sulphur) in water. The proportion usually given is one ounce of the sulphide to two gallons of water, but both Dr. Fisher and Professor Humphrey have found this solution injurious to the foliage and the young cucumbers. A preparation containing an ounce to three gallons is certainly strong enough, and one with an ounce to four gallons is probably so.

As recommended for the lettuce disease, a house in which this fungus has been troublesome should be thoroughly cleaned and fumigated before the next season's crop is started.

THE AGRICULTURAL PRODUCTS OF MADAGASCAR.

M. D'ANTHOUARD, Chancellor of the French Residency at Antananarivo, has recently made to the French Government an interesting report upon the economic condition of Madagascar, a translation of which appears in the *Journal* of the Society of Arts for July 31. In that portion of the report which is devoted to the consideration of the agricultural development of the island, it is stated that the chief agricultural products are sugar, coffee, cocoa, vanilla, cloves, rice, potatoes, tamarinds, indigo, wine, oranges, and lemons. Sugar cultivation was first commenced in 1842; and two factories were erected at Manangary. Good results were obtained in the first two years; but, during the third year, riots took place among the workmen, and the plantations were destroyed. In 1878 three new factories were established in the neighborhood of Tamatave; and in 1883, on the outbreak of hostilities between France and Madagascar, they were in full working. At the present time, the number of plantations round Tamatave has greatly increased; and also in the south, towards Mahanoro and Vatomandry. The expenses of cultivating are greater near Tamatave, by reason of the high price of land and the scarcity of labor, than in the south, towards Vatomandry and Manangary, where labor and land are cheap. Leases are usually granted for twenty-five years, renewable at option. They may even be granted for a period of ninety-nine years.

Coffee trees grow well in Madagascar; and it is stated to be by no means an uncommon thing to see plantations that are forty-five years old, and even more, which have never ceased to yield good results. European travellers, it is said, are frequently struck by the healthy appearance and the quantity of berries in most of the plantations made round the houses or in the villages inhabited by the natives, even when these plantations appear to be abandoned and left to take care of themselves. A large plantation has recently been established in Imerina by a French company; it extends over an area of about 800 acres. Great results are expected from the development of the coffee industry in Madagascar, as the difference between the cost price and the price it realizes in European markets allows of a considerable outlay on its cultivation and then leaves a large margin of profit.

The cocoa tree was introduced into Madagascar by means of seeds brought from the Mauritius and Reunion, in which places it has been for a long time a source of considerable revenue. The tree commences to bear at the end of three years, but it is only in full bearing at the end of the fifth year, and it so remains for thirty years. The cost of cultivation is less than that of coffee. The cocoa tree is chiefly cultivated in the eastern portion of the island, and it is only of recent years that the industry has assumed any importance. In 1883 there were not less than five or six thousand trees round the coast, and these were abandoned when the war broke out. After the war it was found that, notwithstanding the want of care and attention, the young cocoa plantations were still flourishing, and this phenomenon encouraged the planters to pay greater attention to the development of this cultivation. This development dates from the year 1888. Like cocoa, vanilla is one of the agricultural products which has a great future before it in Madagascar, and its cultivation is largely engaged in in Vatomandry, Mahanoro, and Mahela. Vanilla plants commence to yield after the third year, and in the fourth they are in full bearing.

The cultivation of rice, which is well-developed in the interior of the island, is very much less so on the coasts, where the land is more fertile. While in the latter districts the inhabitants are content to sow the seed without any preparation of the ground but the burning of the trees and grass, the Hovas and the Betsileos, having a much poorer soil, take more pains to develop and perfect their system of cultivation. In some instances, for example, in the neighborhood of Antananarivo, they have transformed immense tracts of marsh land into rice plantations. The plains of Betsimitatatra, towards the west of the capital, which are watered by the Ikopa, Andromba, and Sisaony rivers, now the centre of the rice production in Imerina, have been drained and cleared, irrigating canals have been pierced, and everything has been done to favor the production. Similar well cultivated plains are found in great number in the south of Imerina and in Betsileo. In the mountain districts the rice grounds are laid out in terraces on the slopes of the mountains and hills, and rice grounds are frequently met with rising tier upon tier up to the very summit of the high mountains.

The following is the method of cultivation employed by the Hovas and Betsileos. The rice is first of all sown, then, when it has attained a height of fifteen centimetres, it is plucked up and replanted. The preparation of the ground is an operation to which considerable attention is devoted; it is first of all heavily manured, and when the seed is sown and commences to shoot up, it is subjected alternately to the action of the sun and moisture. In the transplanting, the same system is followed as in other rice-growing countries, care being taken to choose a wet season of the year. The ground must, first of all, have been subjected to various treatments, which would have the effect of transforming it into a kind of mud. In many districts this is effected by trampling over the inundated lands, already softened by driving herds of oxen over them. An improvement in the methods of cultivation practised by the natives of the coast, and of the means of transport, would, it is said, give to this industry its old importance. As regards the future of rice cultivation in the interior, it would never rise beyond the needs of local consumption, as it would be impossible for a low-priced product such as this to bear the heavy expenses of transport by land. Its cultivation, however, would prove remunerative to farmers and others if they would establish factories for the distillation of the alcohol obtained from the rice. At the present time, in the interior of the island, a tenth part of the rice lands only are cultivated, and this suffices for the requirements of home consumption.

Potatoes are largely cultivated in the districts round Ankaratra, and considerable quantities are placed upon the neighboring markets and at Antananarivo, principally for the consumption of the natives. Tamarinds are common all over the west coast, where the plants form immense thickets. The Sakalaves distil spirits from the fruit. Peaches grow almost wild all over the island, and the same may be said of the indigo plant.

As regards vines, there are different species in Madagascar. One variety was originally imported from Portugal; another variety appears to be indigenous to the soil. In Imerina attempts have been made in recent years to acclimatize vines, but some which were brought from Bordeaux have not succeeded. On the other hand, American vines have prospered, but the grapes are not of a superior kind, and the wine made from them is very poor. Orange and lemon trees are found all over the island, growing in a wild state on the coasts, and cultivated in the interior.

As regards textiles, ramie, flax, cotton, and hemp are grown. Plantations of the former were made at Vatomandry, in 1882, which have since increased. The want, however, of decorticating machines has caused this cultivation to be abandoned. Hemp is cultivated in Imerina and Betsileo. Cotton was formerly an important cultivation in Madagascar. The natives gathered it, and themselves manufactured the fabrics, which served them for clothing. Since the importation, however, of American and English cottons, the local industry has been almost killed. M. d'Anthouard says that in view of the fact that cotton grows so easily and quickly in Madagascar, more particularly in the territories bordering on the west coast, where it may be found almost in a wild state, it seems extraordinary that no one, up to the present, has thought of making cotton plantations, either for the export of the raw material, for working it up on the spot, and selling the yarn to the natives, or even for making fabrics which, seeing the heavy expenses of freight and transport which bear upon foreign products, would compete very favorably with similar American goods.

IS THE MARINER'S COMPASS A CHINESE INVENTION?

A WRITER in the *North China Herald* of Shanghai devotes a learned article to detailing and discussing the facts regarding the claim of the Chinese to have invented the mariner's compass. They did not learn the properties of the magnetized needle from any other country. They found it out for themselves, though it is impossible to point to the man by name who first observed that a magnetized needle points north and south. He suggests that it came about in this way. The Chinese have in their country boundless tracts of ironstone, and among these no small portion is magnetic Every woman needs a needle, and iron early took the place of the old stone needles, and were commonly used before the time of Ch'in Shih-huang — that is, more than twenty-one centuries ago. Whenever a needle happened to be made of magnetic iron, it might reveal its quality by falling into a cup of water, when it happened to be attached to a splinter of wood, for example. It came in some such way to be known commonly that certain needles had this quality. The great producing centre for magnetic iron is T'szchou, in southern Chihli. This city was very early called the City of Mercy, and the magnetic stone produced there came to be known as the stone of T'szchou, and so *t'szshih* became the ordinary name for a magnet. Later, the Chinese began to speak of the city as the "City of the Magnet," instead of calling it the "City of Mercy." The polarity of the magnetic needle would become known to the Chinese of that city and its neighborhood first. The first who noticed the polarity would be some intelligent person who communicated the fact as an unaccountable peculiarity in an age when omens and portents were diligently sought for in every natural object and phenomenon.

The earliest author who mentions the "south-pointing needle" lived in the fourth century B.C. There can be no reasonable doubt that the polarity of the needle was known at that time. The discovery of the fact must have preceded the invention of any myth embracing it. As to the discovery, there is no reason to suppose it was in any way foreign, because the Chinese use an enormous number of needles, and have an inexhaustible supply of ironstone. But though the polarity was known, it was not turned to a practical use till the Tsin dynasty, when landscapes began to be studied by the professors of *fengshui*, or geomancy. There was at that time a general belief in the magical powers of natural objects. This was a Buddhist doctrine, and it took firm hold on the Chinese mind of that age. The Chinese philosophers of those times taught that indications of good and ill luck are to be seen all through nature. The polarity of the needle would take its place in this category of thought. Though it is not distinctly mentioned by writers of the fourth century, yet to their disciples it became an essential part of the landscape compass which the professors of *fengshui* all use. Kwo Pu, the founder of this system, died A.D. 324, and it was not till four centuries later that the *fengshui* compass began to assume its present form.

The compass used by the professors of geomancy for marking landscape indication was first made about the eighth century. It was of hard wood about a foot wide, and it had in the centre a small well in which a magnetized needle floated on water. On the compass were inscribed several concentric circles, as on the wooden horizon of our globes. They embrace the twelve double hours, the ten denary symbols, eight diagrams, and other marks. This compass was used in preparing a geomantic report of any spot where a house or tomb was to be constructed, so that the construction might not be upon an unlucky site or planned in an unlucky manner. At the same time there was living a Chinese who had studied Hindoo astronomy, and was the imperial astronomer, and also a Buddhist priest. He noticed that the needle did not point exactly north, and that there was a variation of 2° 95'. This variation went on increasing till a century later, that is, till the ninth century. A professor of geomancy then added a new circle to the compass. On this improved compass the first of the twelve hours begins on the new circle at 7½° east of north.

The compass, it will be observed, grew out of the old astrological report or nativity paper, calculated from the position of the stars, and prepared in the Han dynasty by astrologers as a regular part of social life, especially when marriages were about to be solemnized. Some of the old astronomical circles are preserved in the new geomantic chart. This was the compass used when Shen-kwa wrote on the south-pointing needle in the eleventh century. This author mentions that any iron needle acquires polarity by rubbing it on a piece of loadstone. He alludes to the variation as a fact which he himself had observed, and speaks of the south-pointing needle as an implement used by the professors of geomancy. By them it was employed in the form of a float upon water. After this, in 1122, an ambassador to Corea describes the use of the floating needle on board ship while he made the voyage. This is the first instance, the earliest by more than a century, of the use of the mariner's compass on board ship, found as yet in any book, native or foreign. The existence of the book in which this is recorded settles the question of the first use of the mariner's compass at sea in favor of the Chinese. At that time the needle floated on water supported on a piece of wood, but in the Ming dynasty some Japanese junks engaged in piracy were captured by the Chinese, and the compass in use on board was found to have the needle dry and raised on a pivot, while still pointing southward. The Japanese had learned from the Portuguese navigators to make a compass of this kind, and probably the needles they used were brought from Europe. From this time, the Chinese adopted the principle of a pivot, and made their compasses without a well of water in the middle to float the needle in. Charts were probably used of a very rough kind, but how far is not known. What is known is that the junk-master was aware of the direction in which the needle must point to reach the port to which he was going. In the Sung dynasty, embracing part of the tenth, as well as the eleventh, twelfth, and part of the thirteenth centuries, Chinese junks went to Persia and India. The Arabs trading to China directly would learn at that time the use of the compass, and would apply it on board their dhows. From them the Europeans learned this useful invention.

The credit of the discovery, both of the polarity of a magnetized needle and its suitability for use by mariners at sea, must, therefore, according to the writer, be given to the Chinese, says *Nature*, in commenting on the article. It is China also that has the credit of having first noticed that any iron needle may be polarized by rubbing it with a magnet. In the thirteenth century the Arabs used a floating compass on their dhows. The needle was made to float on the water by attaching it crosswise to a cornstick or splinter of wood. A magnet applied to it drew it into a north and south direction. They would use Western notation to mark the quarters and intermediate points on the horizon. When, therefore, the mariner's compass was adopted from them, the Chinese 24 points were not communicated. In the European compass the notation of 32 points is Western, and rests on the winds and the sun. In the Chinese primitive mariner's compass the notation is that of the professors of geomancy, and rests on the old astrological division of the horizon into twelve double hours. From the Arab account we learn, what the Chinese accounts do not tell us, that the Chinese floated the needle by inserting it in a splinter of wood.

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.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Crime among Washington Negroes.

A CONTRIBUTOR to the Washington *Evening Star* of the 5th instant, signing himself "A Friend of the Negro," has recently been making some comparative studies of the records of the Washington police courts, and greatly deplores the showing for crime they exhibit against the rising generation of Washington negroes. He states, and there is every reason to believe that his statement is true, that "the police report for the year ending June 25, 1890, shows as follows: assaults on policemen, 162, by whites 75, by colored 87; assaults on special officers, 25, by whites 9, by colored 16. Last year three policemen were killed by negroes, two when attempting to arrest them, and there is scarcely a year that this does not occur. In the *Star* of Dec. 24, 1888, it was stated that there were then in jail, awaiting trial or sentence for murder, 16 persons, 2 white and 14 colored. In the *Post* of March 26, 1890, it was stated that there were then on the calendar 18 murder trials, and in the *Star* of Dec. 29, 1888, it was stated that there had been in the District during the year 26 murders, the greater portion of which was by negroes. Now, when it is borne in mind that they constitute but one-third of the population, it will be seen that this is a terrible record."

Investigating this matter still further, the *Star* correspondent is enlightened in other directions, for he soon finds out that it is the present generation of negroes that is responsible for the majority of these misdemeanors. He finds that it is not only the pseudo-civilized, coal-black Ethiopian, but more frequently the species to which I alluded in *Science* (No. 416) as "the hybrid," that is developing a marvellous fondness for whiskey, who almost invariably goes armed either with a razor or a "bull-dog" revolver, who are the law-breakers, who are rapidly becoming the skilled burglars, and who are far more dangerous than a savage for a lady to meet alone anywhere after dark.

This "Friend of the Negro," mark you, ascertained still more, much of which is quite in tune with the present writer's remarks in the Washington *Analostan Magazine* of last February, and several other quarters. He adds, "What makes it more disheartening is that here they are in every respect in the full enjoyment of all their legal rights, and in all particulars are on a perfect equality as citizens with the whites. They have the same privileges in the schools, are taught the same branches, have the same school buildings, and there is the same amount per capita spent for them as for the whites. They are abundantly provided with churches and Sunday-schools [*sic*], and, in addition, have the example [*sic*] of some of the ablest and most cultured of their race residing here in our midst." (!)

Now to this particular "Friend of the Negro" I would briefly suggest a study of a few of the higher and a few of the more lowly races of man since the dawn of history. Make those studies comparative. Next, master some of the more practical laws — and there are few or none that are not so — of biologic evolution. Get a good realizing sense of how long it has taken the white race to arrive at its present stage of civilization, and especially the fact that races of men are often quite as far separated mentally, intellectually, and psychologically, as are other races of vertebrates. Induce, if possible, some friend who is informed in such matters to impart a few wholesome facts in the premises. If I am not radically mistaken in the grade of good sense of our "Friend of the Negro," at the end of six months' time he will awaken to the fact that he has before him for study one of the most advanced races in civilization on the face of the globe, the "so-called white," which race is now the victim of another and a *parasitic* race, the "so-called negro," — vicious, low, and barbarous, with a race history, so far as it can be traced, (!) that will not bear investigation. It is not so very long ago since some of them were human flesh-eaters. As an evolutionist, as a zoölogist, and as perhaps other things, I can inform the *Star's* contributor that it is quite a useless experiment to place a turkey-vulture in a cage of sky-larks and expect him to sing next morning. Moreover, it is just possible that the experiment may prove a dangerous one for the larks.

DR. R. W. SHUFELDT.

Takoma, D.C., Aug. 10.

BOOK-REVIEWS.

Achievements in Engineering during the Last Half-Century. By L. F. VERNON-HARCOURT. New York, Scribner. 311 p. 8°. $1.75.

THE author of this work has already made himself known as a writer on engineering topics by his previous books on "Rivers and Canals" and "Harbours and Docks." In this book he describes briefly some of the principal engineering works carried out within the last fifty years, avoiding technical phraseology as far as possible. This will, of course, add to the attractions of the book for the general reader, for whom it is mainly intended; but the attention given to details, and the comparisons made between similar works carried out under different circumstances, give the book a special value for engineers.

There has been no lack of material for the book. In fact, one of the chief difficulties in the preparation of a work of this kind, when undertaken with due regard to "perspective," is the judicious selection of subjects. In this respect, we think, the author has made no mistake. Beginning with railways, he treats first of the London underground and the New York elevated roads; then of those crossing the Alps, the Andes, and the Rocky Mountains; after which a chapter is devoted to narrow-gauge, Fell, Abt, and the Rigi and Pilatus railways.

Two chapters are given to tunnels, one being devoted mainly to those piercing the Alps, the other treating of river tunnels, such as the Detroit, Hudson, Mersey, Severn, and Sarnia, and the Thames subways. After a chapter on the progress and principles of modern bridge construction, he gives some details concerning the Hawkesbury, St. Louis, Garabit, Hooghly, Brooklyn, Forth, and Tower bridges, with some remarks on the possibility of a bridge across the English Channel. A brief chapter on submarine mining and blasting relates principally to the operations at Hell Gate in the East River.

The engineering works involved in the improvement of the chief sea-ports of the world and of some of the great river channels are very fully described; and ship-canals are by no means neglected, two chapters being given to the Amsterdam, Manchester, and Suez canals, as well as to the work thus far done on the Panama, Corinth, and Nicaragua canals. The latter, by the way, he locates on the Isthmus of Panama, under which name he seems to include all the territory extending from the mainland of South America as far north as the United States.

In the last two chapters of the book the author writes of the Manchester water-works, the Vyrnwy dam and lake, the Eddystone lighthouse, and the Eiffel tower. The book is handsomely illustrated, full-page views being given of many of the subjects treated of, and an excellent portrait of Robert Stephenson making an appropriate frontispiece.

As a whole, the book is one to be commended, though there are points in which it might be improved, as viewed from an American standpoint; and there are occasional evidences of hurried work, as, for instance, the following sentence, which, though conveying much information in small space, would hardly pass muster as a sample of good style: "The elevated railways are owned by two separate companies, and worked by a third company, to whom the lines are leased for 199 years, by means of locomotives, with coupled driving-wheels 3½ feet in diameter, and bogie wheels 2 feet in diameter" (p. 20).

AMONG THE PUBLISHERS.

THE Humboldt Publishing Company have just ready "Mental Suggestion," by Dr. J. Ochorowicz, sometime professor extraordinarius of psychology and nature-philosophy in the University of Lemberg. The preface is the work of Charles Richet.

— Longmans, Green, & Co. have just ready "Cookery for the Diabetic," by W. H. and Mrs. Poole, with a preface by Dr. Pavy; and "With Sack and Stock in Alaska," by George Broke, which will interest all who enjoy records of travel in out-of-the-way lands.

— Charles Collins has just published a fourth revised edition, by Professor Sheldon, of Olmsted's "Natural Philosophy;" also Sheldon's "Electricity," being chapters on electricity prepared for and included in the preceding book, but published separately for the use of students in college.

— Macmillan & Co. call attention to the new work of Louis Dyer, late assistant professor in Harvard University, entitled "Studies of the Gods in Greece." Professor Dyer explains the development of the cults of Demeter, of Dionysius, of Æsculapius, of Aphrodite, and of Apollo. The gods are treated with the reverence that is due to them, and the fact is emphasized that there is much in Christianity that is of Greek rather than Jewish quality.

— D. C. Heath & Co., Boston, have just published a "Manual of Plane Geometry," on the Heuristic plan, with numerous extra exercises, both theorems and problems, for advanced work, by G. Irving Hopkins, instructor of mathematics and physics, Manchester High School, N.H., with an introduction by Professor Safford of Williams College. The book is designed primarily for the author's pupils, and secondarily for the constantly increasing number of teachers who are getting more and more dissatisfied with the old methods of teaching geometry.

— G. P. Putnam's Sons have just ready the third part of the "Talleyrand Memoirs." This instalment continues the report of the Congress of Vienna in 1815, the Second Restoration, and the Revolution of 1830. It contains three portraits of Talleyrand, one after F. Gerard, one from a bust by Michelet, and one from an engraving by Napier. They have also ready "The Leaf-Collector's Hand-Book," by Charles P. Newhall, which is intended as an aid for students in classifying the leaves described in the author's former volume on "The Trees of North-eastern America," published last fall. A third volume on "The Shrubs of North-eastern America," is in preparation.

— The Century Company will publish George Kennan's "Siberia and the Exile System" this autumn. The book will appear simultaneously in England, France, Germany, and Holland. Unauthorized editions have already been published in Russia, Poland, Hungary, and Bulgaria, and many of the magazine articles have been reprinted in Italian and Swedish. Five unauthorized German editions have been issued.

— The Open Court Publishing Co. have issued a small book by Th. Ribot entitled "The Diseases of Personality," being a study of insanity and other abnormal and diseased conditions of body and mind. It partakes of the general character of recent French works in physiological psychology, but bears at the same time the marks of the author's individuality. It presents a large collection of facts relating to the theme of the book, and in that respect will be useful to all students of the subject; but the author's theories seem crude and unscientific. His idea of personality itself is vague and uncertain. Sometimes he speaks as if he thought personality the same thing as consciousness; but near the close of the book he says that "the organism and the brain as its highest representation constitute the real personality" (p. 156). Elsewhere he speaks of the "dissolution of personality," and of the "transformation of the ego;" and again, in speaking of a man who is sometimes drunk and sometimes sober, he asks: "Have we not here, as it were, two incomplete and contrary individuals welded together in one common trunk?" Such notions indicate a strange aberration of judgment; and it is certainly not by theories of that sort that mental derangements can be explained.

— The Fleming H. Revell Company have ready the "Life of John Kenneth Mackenzie," medical missionary to China, written by Mrs. Bryson, who was an intimate friend of the doctor's from 1875 until his death in 1888, and worked with him in central China and afterwards on the banks of the Pei-ho.

— Professor John Fiske will open the September *Popular Science Monthly* with a paper on "The Doctrine of Evolution: its Scope and Influence;" and Herbert Spencer writes on "The Limits of State-Duties," in which he maintains that an industrial State should not attempt to mould artificially the minds and characters of its citizens. Continuing his Warfare of Science series, Dr. Andrew D. White will relate, in the same number, how hygiene succeeded fetichism as the reliance of the Western world in checking the ravages of epidemics. A fifth paper, concerning "Glass in Science," will be added to the illustrated series on glass-making, by Professor C. H. Henderson, describing the making of spectacle-glasses, the grinding of lenses for telescopes, the blowing and graduating of thermometer-tubes, the making of hydrometers, etc.; and the question "Can we always count upon the Sun?" is asked, though not in any sensational manner, by Mr. Garrett P. Serviss. The sun-spot period now approaching its maximum makes this query very timely.

— Henry Carey Baird & Co. have just issued a complete treatise on "The Electro-Deposition of Metals," translated from the German of Dr. George Langbein, with additions by William T. Brannt, editor of "The Techno-Chemical Receipt-Book."

— The "Manual of the Paleontology of the Cincinnati Group," by Joseph F. James, Part 1 (Journal Cincinnati Society Natural History, April, 1891, issued July, 1891), is part one of what is designed to be a manual of the fossils of lower silurian age in the vicinity of Cincinnati. The necessity of some such work as this will be better understood when the fact is recalled that the five or six hundred species of fossils known from the locality are described in many different publications, such as State surveys, reports of societies, and scientific journals, extending over many years. The reports of the Ohio and New York surveys contain many, but by no means all, of the species. If the plan of the present publication be carried out, it will include descriptions of all genera and species recorded from the Cincinnati formation. The present, the first part, treats of *Plantæ* and *Protozoa*. The author does not believe the so-called marine plants described from the formation are really such, but refers them to inorganic causes, markings of organisms, annelid trails, etc. Two species of Heterophyta (*Cryptogamia*) are described, one of which, however, is considered problematical. The *Protozoa* include two orders, *Foraminifera* and *Spongida*. Of the first one genus and two species are described, and of the second fourteen genera and nineteen species. Two new species, *Rhombodictyon globosus* and *Cyathophycus siluriana*, are described and illustrated.

SCIENCE

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SCIENCE

NEW YORK, AUGUST 21, 1891.

THE PRODUCTION OF MUSICAL NOTES FROM NON-MUSICAL SANDS.[1]

THAT I have succeeded in producing musical notes from sand that was never before musical, and am also able to produce similar results from certain mute or "killed" musical sands which have been temporarily deprived of their musical properties, has already been announced in the *Chemical News* (vol. lxiv. No. 1650).

It is not necessary now to give the details of the numerous experiments which led up to this discovery; it will be, perhaps, sufficient for present purposes to state that in November, 1888, I published a paper (read before the Bournemouth Society of Natural Science) in which I propounded a theory to account for the cause of musical sounds issuing from certain sands. After giving various reasons for my conclusions, I said: "It occurred to me, then, that the music from sand was simply the result of the rubbing together of the surfaces of millions of perfectly clean grains of quartz, free from angularities, roughness, or adherent matter in the form of clinging fragments investing the grains, and that these microlithic emissions of sound, though individually inaudible, might in combination produce a note sufficiently powerful to be sensible to us."

Having described numerous experiments, and drawn attention to the hopeful results obtained from the "millet-seed" sand, my paper concluded with the following: "From what I have now told you, I think we may conclude that music may be produced from sand if (1) the grains are rounded, polished, and free from fine fragments; (2) if they have a sufficient amount of 'play' to enable them to slide one against the other; (3) if the grains are perfectly clean; and (4) if they possess a certain degree of uniformity in size, and are within a certain range in size."

On June 20 last I visited Studland Bay for the purpose of carrying out some new experiments. I found that the musical patch emitted tones louder and more pronounced than I had ever heard them before. The best results were obtained by drawing a thick deal rod, on to the end of which I had fixed a resonator, over the surface of the sand; sounds produced in this way were heard unmistakably for a considerable distance. The patch averaged 7½ yards in width, and ran parallel with the trend of the shore for some hundreds of yards. The sand on the sea side of the patch was fine, and emitted notes of a high pitch; that on the land side was coarse, and emitted notes of a lower pitch. The rod drawn across the patch gave, therefore, a great variety of pitch. Many other interesting facts cannot now be referred to, but it is important to state that some of this sand, when taken off the patch and struck in a box, gave out notes as it did *in situ*. On trying this sand subsequently at home, the coarse emitted distinct notes of a low pitch, but the fine was mute. This was, so far as I know, the first time that the Studland sand had been musical off the patch.

According to my theory, if the number of grains with the polished surfaces could be increased in this fine sand, the number of vibrations would increase also, and so intensify the note, and cause it to become audible; this could only be done, however, by introducing a certain percentage of grains fulfilling the required conditions. To obtain such grains and to introduce them gradually until the necessary number should have been added, would have been a tedious process; and it occurred to me then that the same result might be obtained if the sand were struck in a vessel with a hard and polished interior. I placed, therefore, this fine sand in a teacup, and, on striking it, found that it emitted a high, shrill note (A in *altissimo*), which was far more intense than that given when it formed a part of the patch.

When polished grains of sand are in contact with the sides and bottom of a glazed porcelain vessel, it is obvious that there are numerous points of contact between two polished surfaces, — the sand grains and the vessel, — and that on striking the surface of the sand, the friction necessary to produce the vibrations of a musical note is induced between these points.

This I proved by placing the same sand in various vessels with rough interiors, and by lining these glazed or polished vessels with silk, etc., but in no case would this sand emit notes unless the grains were in direct contact with the glazed or polished surfaces. This peculiarity is not in any way dependent upon the sonorous properties of the vessel used, for it may be "deadened" with impunity, and the note will remain unaltered.

The results of numerous experiments show that musical sand of the Eigg type — i.e., sand possessing in great perfection the physical conditions necessary for the production of music — will be musical in receptacles of whatever composition or form, though in some of these it emits notes "under protest" only.

Those sands which are of the Studland Bay type — i.e., having the necessary physical conditions less perfectly developed, and usually mute except *in situ* — will emit music only in vessels possessing hard and glazed interiors, and, as a rule, of a certain form; while some of the more "sulky" types of sand not only need a vessel of hard and glazed interior, and definite form, but also require a box, or small pedestal of wood (which I call a "coaxer"), on which this vessel must stand before the notes emitted become audible. A "sulky" sand was rendered far more musical by being sifted, washed, and boiled, giving out, after this treatment, notes without the aid of the "coaxer."

After discovering what could be done with such simple apparatus, it occurred to me to try, under similar conditions, some of my abandoned sands — those unmusical sands that had been, during a period of four or five years, treated unsuccessfully for music.

One sand (an iron-sand composed of more or less polished grains, quartz, and much dust formed of denser minerals) gave a very hopeful "swish" (explained in my paper of 1888) in a certain porcelain vessel, and from this — by (1) sifting in sieves, to eliminate the fine material, and to insure uniformity in size of grain; (2) rolling down an inclined plane of frosted glass, to separate the rounded grains from the angular quartz; and (3) boiling in dilute hydrochloric acid, to cleanse the surfaces — I succeeded in producing a sand that, in certain glazed vessels, emits musical notes as clear as those emitted from any of my musical sands but that of Eigg. This sand gives F in *altissimo*, but it soon becomes "killed" because of the fine dust and loss of polish that is the inevitable result of the attrition of the grains. There remains but one thing to be done, and that is to produce a sand which, like that of Eigg, will be musical in almost any receptacle, and I have reason now to think that this will not be very difficult.

It has not been possible here to record more than the merest outline of what has been done, or to give instances of the interesting capriciousness of these sands; it should be understood, however, that no ordinary beach or cliff sand has the slightest inclination to "sing" under any of the "coaxing" methods at present known to me.

[1] Cecil Carus-Wilson, in Nature of Aug. 6.

IT is stated in *Nature* that Siam, following the example of Japan, is commencing to Europeanize her institutions. The founding of a university has been decided upon, and Professor Haase of Königsberg has accepted the appointment to the chair of physics.

SEA-SICKNESS.[1]

SEA-SICKNESS is one of those minor miseries of existence for which there appears to be no cure. Many have been loudly trumpeted, but none have really succeeded in susceptible persons. As a matter of fact very little serious study has been given to the subject; persons who do not suffer are apt to despise those who do, and persons who do suffer are too glad to forget their misery to be disposed to give any thought to its source. Professor Rosenbach of Breslau has recently published a small monograph, the outcome of observations and study of the phenomena of sea-sickness extending over ten years. He gives his experiences in the form of a thesis, which he uses as the basis of his explanations and arguments as to the nature of the disease.

His argument of facts is as follows: 1. The malady commences as soon as the vessel pitches, that is, rotates on its transverse axis. 2. The rolling, that is, rotation on its long axis, is less severe, but the combination of the two is very unfavorable. 3. The phenomena appear more quickly and are more severe the farther the patient is from the middle of the ship. Persons sleeping are attacked, also small children and animals. In small boats without sails very sensitive persons may be affected; when sails are used sickness is more likely to occur. 4. A moderate amount of food in the stomach and a small quantity of alcohol is more likely to act as a preventive than an empty stomach. 5. The horizontal position on the deck acts in some degree as a preventive. 6. Anxiety and apprehension precede sickness; a certain exhibition of energy and resolution may in short voyages and with slight vessel motion control the tendency to sickness. Soft winds (for example, sirocco), strong odors, etc., are unfavorable. 7. There are two categories of the affection dependent on individual predisposition; in one the head, in the other the abdomen is principally affected. Cases where both are affected are common.

In regard to intensity: (*a*) Some women begin to feel uneasy from the beginning of the voyage, in perfectly smooth conditions of the surface; they are pale, and have no appetite. There is a certain dread also. It is questionable if they are cases of sea-sickness. Perhaps they represent the purely psychical form. (*b*) In another variety there is a general irritation of the nervous system during the whole voyage. The digestive organs are unfavorably affected. (*c*) This series forms a transitional variety. Slight motions of the vessel affect sensitive persons and produce sickness with general loss of appetite, indisposition to move or speak, and painful sensations in the head or abdomen. These symptoms are a delicate reagent to the disturbing action of the vessel.

As to the theories of the disease, they are arranged under three heads: 1. The psychical theory (so named by the author), according to which all the symptoms are produced through the action of certain sensory organs upon the consciousness, giving rise to uncomfortable or unwonted sensations or disturbed equilibrium. 2. The theory of disturbed equilibrium, according to which the permanent disturbances of equilibrium act as painful irritations to the contents of the skull and of the abdomen, and are thus the causes of the phenomena. 3. The theory of the disturbance of the circulation, according to which the disturbances of equilibrium and the swinging motions of the body produce circulatory disturbances in certain parts.

As regards the psychical theory, the arguments generally adduced in its favor are: 1. That the sight of the pitching vessels and of the up and down motions of the vessel favor the occurrence of sickness. 2. That the abnormal effects do not occur with the eyes shut. 3. That sleepers generally escape. This conclusion the author rejects, for he states that energetic will and closure of the eyes do not quite succeed in warding off the attack.

The action of visual disturbances in inducing the sickness he considers very important, but only secondary as factors in the result. That the sufferers may be roused from sleep in a full paroxysm of the attack; that children at the breast and young children suffer, though less than adults; and that horses, who in their boxes do not see the movements, also suffer — these facts prove, the author states, that the external mechanical influences alone must be the cause of the sickness. These facts, on which the author seems to rely for his conclusions as to the secondary importance of visual disturbances, if in themselves correct, do not appear to demonstrate that visual disturbances were absent in the cases mentioned, and it is to be remarked that in a note the author speaks of closure of the eyes or avoidance of the sight of the mast and bulwarks of the ship as being of great assistance in preventing the attack.

The third theory — that of circulation-disturbances — the author rejects. The second theory is particularly developed, and the disturbing effects of various kinds of unwonted improvement are described and analyzed. Thus, it is shown that backward travelling may produce illness, pains, even vomiting. The motion in swings, the effects of circular motion, are next described. The effects of rapid upward or downward motion have been particularly experimented on by the author in the rapidly-moving American elevators. The author thinks that he has discovered a new and substantial explanation of the action of external movement impulse by the phenomena observed in rapid elevators. It is found that in ascending with the eyes closed, no noise being heard, there is experienced a peculiar feeling at the epigastrium which goes off during the rise, say, of four or five floors, but reappears the moment the elevator stops. The same thing occurs when the elevator moves downwards, the sensation being felt only at the outset and on the arrest of the motion. In the motion of the elevator there occurs a sudden movement and sudden arrest of the movement, and the effect of this in producing the epigastric disturbance is held to be analogous to the effect of the motion observed in the vessel at sea. This explanation furnishes a theory which the author accepts, because it covers the ground to the necessary extent. Further, the author is led to the conclusion that the complex symptoms of sea-sickness are due to the molecular disturbances produced by rapid movements arising from sudden change of direction of the motion, whereby a severe intramolecular shaking and irritation primarily acting on the cells and the protoplasm of particular organs is produced.

The immediate transition from one movement to another movement in a different direction is assumed to be the cause of the disturbances experienced. Thus the painful sensations in sea-sickness, in the act of swinging, in the oscillation liable to occur in rapid railway journeys, agree in this, that the peculiar symptoms of irritation, the distressing feeling at the epigastrium, the cold sweats, the general feeling of illness, and the headache, appear at the moment when the direction of the movement changes.

As regards the cure of sea-sickness, the author considers that the only real cure is "custom." He speaks favorably of certain medicines as being often operative for very short sea voyages — quinine, antipyrine, bromide salts, cocaine, morphine, chloral, and other anæsthetics. He speaks with approval of the advice of older writers that the horizontal position at mid-deck should be taken before the voyage begins, and that a bandage should be tightly placed over the liver, whereby the intensity of the motion is diminished, and a certain degree of fixation of the abdominal contents promoted.

Professor Rosenbach has made a most valuable and suggestive contribution towards the solution of the much-vexed question as to the nature and cause of sea-sickness; and no doubt his views will excite discussion calculated materially to advance our knowledge of the subject.

[1] From the British Medical Journal.

DIET AND ANIMAL TEMPERATURE.

A QUESTION has been put to us by a correspondent, says the *Lancet*, whether the animal temperature of persons who subsist on a vegetable diet is lower than that in animal or mixed feeders. The inquiry has never been investigated in the human species on a sufficiently comprehensive scale to be of any value, but such comparative facts as throw light on the matter tend to indicate that vegetable feeders, among the lower creation, have a high temperature. Dr. John Davy, brother of Sir Humphry, and one of our keenest physiological observers of a past day, was among the first to make comparative observations of the temperature of different animals in their normal state; and to a certain extent John Hunter, Pallas, Despretz, and Samuel Metcalfe carried out the same research. In 1869 Dr. B. W. Richardson, in one of his lectures on experimental and practical medicine, classified the results of most of these previous authors, and tested them by a new series of direct observations. His table of mean results showed that vegetable feeders have a high temperature. The sheep gave a temperature of 104°, the goat of 104°, the pigeon of 108°, and the common fowl 108°. The rabbit showed 103°, while the dog and the cat, animal or mixed feeders, showed 102°. But some herbivora were comparatively low, the ox, for example, 101°, and the horse 100°. The differences here stated were supposed by the last-named observer to depend on the cutaneous covering of the animal more than on any other cause. In the case of the pigeon, on which this author made ninety-four observations, the high temperature was attributed to the non-conducting character of the feathers, a marvellous protection to a swift-flying animal in a cold atmosphere. In man, from 100 observations, he came to the conclusion that in a strictly natural state 98° F. was the truest standard. These researches are useful as comparative studies; still, it is an open question whether in man, or in any species of animal that can live on a mixed diet, there is a variation of temperature according to the mode of diet; and it would be a good work to inquire on a large scale if, under a purely vegetable form of dietary, the temperature in man is reduced. Our correspondent informs us that in him (a healthy man) and in his wife (a healthy woman), both in the prime of life, the temperature now ranges from 96° to to 97.4° F. He for three years and a half, and she for two years and a half, have been total abstainers from alcohol, and have subsisted on fruit and vegetables, with addition of "butter, cheese, milk, eggs, and a little fish." Previously to adopting this system his temperature had never fallen under 98° "in so far as he remembers," and he therefore is inclined to the view that under his new regime he lives as healthily as before, at a lower expenditure of energy. If such prove to be correct, and if it should be demonstrated that a minimum animal diet (for our correspondent, be it observed, is not strictly a vegetarian) will support life efficiently under reduced combustion and reduced waste of material, a valuable as well as curious fact will be added to our practical knowledge. Evidently there is here open a fine field for a patient, perfectly unbiased, and truthful investigator.

EVOLUTION.[1]

IN the course of that theory of natural science best known to the outer world as that of evolution or development (whereof Darwin was the principal expounder), it becomes necessary for the theorist to endeavor to bridge over the gaps which are very easily to be discerned betwixt existing classes of animals. No doubt geology has supplied not a few of those "missing links," and has undoubtedly proved, for example, how the modern one-toed horse has descended from a four or five toed ancestor; and how birds and reptiles, which every zoologist knows are near kindred, can be linked by at least one fossil bird, which is neither bird nor reptile, but a very decided mixture of both groups. Still, the geological record is an imperfect one, and always will be. If every living thing which had ever existed had been preserved in a fossil state, and had been placed at the disposal of the geologist and anatomist for investigation, there might have been few or no difficulties in the way of piecing together the bits of the puzzle of life. As, however, fossil animals and plants constitute the mere chance preservations of the life that was, we have perforce to be content with a very meagre knowledge of existence in the past ages.

There remains, however, another method of arriving at the relationship which science seeks to show exists between apparently diverse groups of animals and plants. In plain language, when we study the development of an animal or a plant, and see how it works its way from the germ to become the adult form, we are brought face to face with a series of changes and scenes which are significant enough to the thinking mind. Suppose we discover that a frog begins life as a fish, a fact every schoolboy knows, what is the meaning of this strange becoming on the part of that tailless animal? Natural history replies that the frog's development we see to-day is really a recapitulation of its past descent. Witnessing how a tadpole becomes a frog, we are really looking at a moving panorama of the rise and progress of the whole frog-race, whereby that race must have sprung from a fish-like stock, and must have gradually grown into the lung-possessing, air-breathing creatures of the present time. This seems to be the only reasonable interpretation to be placed upon the marvellous changes which we see represented in the development of animals and plants; and this, at least, is the meaning which science attaches to the unfoldings of form and structure discernible in the course of the living being's progress from its beginning, in the egg, to its assumption of its adult character.

In the course of studies in the development of animals, we meet with some very curious discoveries and theories relative to the origin of the various zoological groups; and certain ideas of the origin of backboned animals at large, lately promulgated, seem to be worthy of mention here, as tending to keep us *au courant* with the progress of thought in biology. The puzzle of naturalists has been that of accounting for the origin of the vertebrated animals aforesaid, because these backboned tribes (which range from the fishes to quadrupeds) seem really to stand out very distinctly and by themselves as a specially defined sub-kingdom. The backboned branch of the animal tree, in other words, has presented great difficulties in its being traced to its connection with the parent stem. There is a certain fish, the lowest of its class, called the lancelet, which is found to present, both in its development and in its adult structure, certain close affinities to a lowly tribe of creatures known as tunicates, or sea-squirts. A sea-squirt is simply a kind of animated bag with two openings, somewhat like an ancient "leather bottel," which remains attached to a rock or stone. Hence, from the likeness between the sea-squirt's development and that of the lowest fish, many zoologists are given to regard the former as the putative parent of the vertebrate animals. The sea-squirt, in this view, is the very far-back ancestor (or representative of the ancestor) of the backboned tribes.

More recently, however, certain adventurous spirits in biology have ventilated new ideas of the origin of the backboned forms, and these ideas, I fancy, are more startling even to biological minds (given to feel surprised at nothing whatever) than any previous theories which have been advanced. Seeking for the ancestors of backboned animals among the annelids or worms has not been a process attended by success, in so far as evidence of probability is concerned; but higher in the series of jointed or articulate animals we find the insects, spiders, and crustaceans, of which class the lobster is a fair representative. One scientist declared that for choice he finds the most likely origin of the backboned tribes in the spider-class. What induces this belief is the tendency to head development, among other signs of advance, which the spiders, scorpions, and their allies exhibit. What we call a scorpion's head is really its head and chest united, and a close examination of this region shows that in the arrangement of its nerve-masses, its nerves, sense-organs, and so forth, there is to be traced a very exact resemblance to the similar arrangements in the vertebrate head. Again, it is held that in the development of the scorpion and spider, essentially similar features to those seen in backboned development are to be traced. So that the far-back ancestor of the highest animals, on this belief, are to be sought for in some primitive scorpion, which, getting on in the world, gave origin to the higher group. There might be a difficulty regarding the transition from air to water, from scorpion to fish, no doubt; but I presume it is maintained that out of a common type of primitive breathing organ the modification in question could easily have occurred.

The other theory of vertebrate origin also sees the ancestor of backboned animals in some primitive jointed animal or other. Tracing the development of the backboned brain and spinal cord, an observer regards these important structures as having been formed by the elaboration of jointed nerve-masses placed on the outside of a tube. There is such a tube in the middle of the spinal cord, and this tube extends onwards into the brain. The bold idea has therefore been formulated that the central nervous canal of the backboned tribes represents the digestive tube of the vertebrate ancestor; certain dilatations of the tube in the brain corresponding to the stomach of that ancestor, whose own nervous system (lying

[1] Dr. Andrew Wilson, in the Illustrated News of the World.

below its digestive tract) has become transformed into the backboned nervous belongings. There is, however, the big liver of the ancestor to be reckoned with. Where has it gone to in the course of the transformation? In the young lamprey it is shown that a kind of temporary liver may be regarded as existing in the brain, and this is looked upon as the rudiment or remnant of the liver which was once the possession of the vertebrate's ancester. On the whole, it may be said, we are getting on very nicely in biological theory; and, whether we accept the views thus set forth or not, we may at least feel some curiosity in knowing how modern speculation is deriving the vertebrates from lower forms, and how the modern backboned animal is thought actually to carry in its spinal cord the remnant of the ancestral digestive system.

NOTES AND NEWS.

THE Hon. C. B. Farwell of Chicago received a telegram on Aug. 11 from Professor Dyhrenfurth, in charge of the rain-producing experiments provided for by the last Congress, now being conducted on the ranch of Nelson Morris, in Texas. The professor says that the first experiment was made on the 10th, powder being exploded high in the air; and that it rained heavily there on the 11th.

— Mr. F. Howard Collins, the author of a useful epitome of Mr. Herbert Spencer's system of philosophy, has written a pamphlet in which he discusses the causes of the diminution of the jaw in the civilized races. In opposition to the views of Weismann, says *Nature*, he contends that the phenomenon is due to disuse.

— A recent issue of *Nature*, quoting from *Das Wetter* for July, reports a curious case of globular lightning which occurred at Berga, near Schlieben, in Germany, between 3 and 4 o'clock on the morning of July 1. The lightning entered the chimney and split into two parts, one portion running along the rafters of the roof, and the other entering a bed-room occupied by a man and his wife and three children. The man, who was up, on account of the violence of the storm, saw the ball jump on to the bedstead, which it broke, and from there it slowly travelled to the opposite side of the room, and disappeared, with a loud crash, through the wall. None of the occupants were injured, further than being deafened for a short time.

— The Vienna correspondent of the London *News*, recalling that paper's description of the Roman remains at Hainburg, about twenty-four miles from Vienna, on the site of the ancient Roman frontier town of Carnuntum, on their discovery a year or two ago, says that new excavations are now taking place in the immediate neighborhood of the Castle of Petronell, the residence of the Counts of Abendsberg Traun, which is about two miles distant from Hainburg, and have resulted in the discovery of many interesting architectural remains and much sculpture. These discoveries lead to the conclusion that Carnuntum must have been a much larger town than was thought, for it seems that it must have contained several hundred thousand inhabitants.

— It is the fashion to write articles on theories of rest and how to obtain it, says the *Illustrated American*. Anna Brackett contributes an admirable paper, entitled "The Technique of Rest," wherein she sets forth the possibilities of absolute rest, both mental and physical, under difficult circumstances. The celebrated Dr. Hammond has also given some very erudite and practical views of the same theme. It would be well for the rushing, hurrying, scurrying, never-resting crowd of workers to stop a moment and listen to such notes of solemn warning; and, at least in the choice of "recreations," to select such diversions as will tend to create exhausted vitality, and not add fresh fuel to a consuming fire. Dr. Hammond lays some stress on the trite truth that rest is often but a change of work. The athlete may rest over a game of chess or whist. The brain-worker of sedentary habit who concentrates a weary mind upon an intricate game which demands unremitting alertness of attention is diverting from his chosen calling just so much mental vigor, — exactly, to an atom, so much vital power. Let those men and women who are thinking for a living stop thinking, as a conscious effort, when they would rest. If she who would plan her life wisely will make a careful estimate of the comparative values of those things which enter into it only by her own consent, offsetting them in the inventory by those demands which are essential, she will draw a pencil through every diversion which is akin to her life-work. If she is a wise journalist or literary woman, she will eschew whist as a wary thief of her powers, whose dangers are even enhanced by her mental habit of self-surrender and concentration.

— Professor Tito Martini of Venice contributes to the issue of the *Rivista Scientifico-Industriale* for the end of June, the results of some experiments on the crystallization of thin liquid films. He finds, according to *Nature*, that a strong solution of sodium sulphate, when cooled to near its saturation point, possesses a viscous character which enables it to form a thin film on a metallic ring, as in Mr. Boys's experiments with soap-bubbles. On rapid evaporation such a film crystallizes to an extremely beautiful open lattice-work of minute crystals, which preserve their transparency for some time, and then effloresce and crumble to powder. The experiments succeeded with rings up to thirty-six millimetres diameter. Similar experiments with ammonium chloride and sodium hyposulphite have hitherto proved unsuccessful. With a transparent film of liquid sulphur, however, even more beautiful results have been obtained. The author regards such experiments, besides being eminently suitable for lecture demonstration, as likely to throw light on the nature of molecular arrangement in relation to crystallization.

— During the last two centuries, says the *Scottish Geographical Magazine*, the Lapps of Norway have been moving gradually southwards, preserving their uncivilized and nomadic mode of life in their new environment. Dr. Yngar Nielsen of Christiania has recently studied this interesting ethnological question (Le Tour du Monde, Nouvelles Géog., p. 137). According to him the southern limit of this people is now marked by the railway from Trondhjem to Östersund, nearly along the 63d parallel of north latitude. To the north of this line are found ancient tombs, places of worship, and names of Lappish origin. Here the Lapps of the present day, though nominally converted to Christianity, retain in secret some of their pagan customs, whereas further south they are good Christians, and have changed even in type. About the year 1600 the southern limit of the Lapps was on the parallel of the northern extremity of the fiord of Trondheim; since then they have made several excursions southward, and have been repeatedly checked by the Norwegian Government. In 1890 they advanced as far as the plateaus of the Hardanger Fjeld. The Norwegians do not resert to violence, but defend their property by legal processes. The question of the Lapp invasion is, however, one that demands the serious attention of the Government.

— In a paper on "Some aspects of Acclimatization in New Zealand," read before the Australasian Association at its Christchurch meeting by Mr. G. M. Thomson, the following remarkable case of hereditary transmission of an apparently defective characteristic was described (New Zealand *Journal of Science*, July). In the district of Strath Taieri, in Otago, some years ago, certain sheep on one of the runs, probably the progeny of a single ram, were found to be evidently short-winded. Apparently the action of the heart was defective, for when these sheep were driven, they would run with the rest of the flock for a short distance and then lie down panting. The result of this peculiar affection was that at nearly every mustering these short-winded sheep used to be left behind, being unable to be driven with the rest. Sometimes they were brought on more slowly afterwards, but if it happened to be shearing time they were simply caught and shorn where they lay. As a result of this peculiar condition a form of artificial selection was set up, the vigorous sheep being constantly drafted away for sale, etc., while this defective strain increased with great rapidity throughout the district, for whenever the mobs were mustered for the market, shearing, or drafting, these "cranky" sheep (as they came to be called) were left behind. This defective character appeared in every succeeding generation, and seemed to increase in force, reminding one of the Ancon sheep referred to by Darwin. At first, of course, the character was not recognized as "hereditary," but as the members of this cranky breed increased to a very serious extent and spread over the district, it came at last to be recognized as a local variety. When the runs, on which these sheep were abundant, were cut up and sold or re-leased in smaller areas a few years ago, the purchasers found it necessary for the protection of their own interests to exterminate the variety, of which hundreds were found straggling over the country. This was easily and effectually done in the following manner. As soon as a sheep was observed it was pursued, but after running for a couple of hundred yards at a great rate of speed, it would drop down panting behind a big stone or other shelter, and seemed incapable for a time of rising and renewing its flight. It was immediately destroyed, and in this manner a useless, but to the naturalist a very interesting, variety was eliminated.

— M. Paul Barré contributes to the *Revue Française* (April 15, 1891) a short paper on trans-asiatic journeys, from which the *Scottish Geographical Magazine* extracts the following. The Dutchman Ruysbroeck visited Mongolia between 1246 and 1273, but, though he advanced far towards the east, he did not succeed in reaching the Chinese coast. The first European to traverse the whole continent was Marco Polo (1271–1295), who, passing through Turkestan and China, entered Pekin, and extended his journey even to Japan. Irmak Timofeef, a Cossack brigand, opened Siberia to Muscovite influence (1530); and Elisée Bouza (1635), Kopylof (1639), and Sladukhim and Ignatief (1644) succeeded in reaching the north-western limits of this country. Dejnef, in 1648, reached the Gulf of Anadir, and ascertained the existence of a strait between Siberia and America before Behring sailed to that region. Again, Baikof crossed Mongolia in 1654, and entered Pekin as ambassador of the Czar. From this time Russian explorers in Siberia became very numerous, but no one followed in the track of Marco Polo until quite recently. Ney Elias crossed Central Asia in 1872–73; M'Carthy travelled from Shanghai to Bhamo in 1876–78, and thence to the coast; Joseph Martin has crossed Siberia twice; Benoist Méchin and Mailly Chalon journeyed from the Ussuri to Bohkara and Merv; and Przhevalski penetrated as far eastwards as the sources of the Whang-ho. Still more recently (1889) Younghusband traversed Central Asia from Pekin to India, and Bonvalot (1889–90) passed from Siberia through Thibet to southern China.

— On Aug. 13 Gen. Greely sailed for Munich, to attend a meeting of the International Polar Commission. Gen. Greely has been ordered by the War Department to attend this meeting, which is the fourth and final session of the commission, and which completes his work in connection with arctic exploration and scientific investigation of the physics of the polar regions. At this meeting the commission will consider the final scientific treatment of the volumes of physical observations published by the Governments which sent out the expeditions of 1881 to 1883. No less than eleven nations will be represented at Munich. Gen. Greely is the only representative from the United States, having been unanimously elected by the other members of the commission. Gen. Greely, in addition to urging on the commission the general discussion of arctic meteorology, will present to the members a scheme of general treatment for the magnetic observations and results of the studies and investigations of Professor Bigelow of the Nautical Almanac office of the Navy Department. This line of treatment is original, and as it is indorsed by Professor C. A. Schott of the coast survey, the acknowledged authority in this country on magnetics, it is believed that it will be interesting to the scientific world when fully developed.

— The use of the detersive effect of a stream of water, says *Engineering*, has been very general in what is known as hydraulic mining in the western part of the United States, where hills of gold-bearing earth have been washed away by very powerful streams conveyed from elevated sources of water supply in the mountains, the gold being afterwards found in more concentrated form deposited in the valley at points where the current was rapid enough to bear away the earth: but the deposits of earth on the arable lands in the valley below have been so destructive to grazing land that stringent legislation has been necessary to prevent the continuance of this practice in many portions of the country. Recently, however, there has been an application of the same practice, but for a reversed purpose, and that is on a railway line in the State of Michigan, where an available supply of water was used to wash down gravel deposits among trestles or timber viaducts along the line of the road, and in that manner to deposit gravel in such a way as to fill up a solid embankment to the line of the track. By guiding these movable sluiceways and also altering their slope or the supply of the water, the direction and velocity was controlled so as to accomplish the result in a very cheap manner, the expense of such filling being about three cents per cubic yard. At Scranton, Penn., there are numerous piles of anthracite culm in the vicinity of the coal breakers over the pit's mouth at the mines, and recently this material has been put to considerable use under boilers, as people are allowed to take it away at a cost of ten cents per ton. An electric light and power station has been built near one of these culm piles, and the coal taken from the pile to the fire-room by means of a stream of water and a sluiceway. Just outside of the delivery in the fire-room the bottom of the sluiceway is perforated so that the water can pass away, and the fuel is delivered at the fire-room in a reasonably dry condition, as the water passes away from it readily. When the low cost of the fuel and slight expense of its transportation is considered, it is held that the amount of moisture in the fuel is merely an item of lesser expense in comparison with other means of delivery.

— The London *Times* of May 20 gives a melancholy account of the Coreans, extracted from a Japanese paper. An evil genius, says the correspondent, seems brooding over the life of the Corean people, paralyzing every nerve and muscle. This evil genius seems to be nothing else than a wretched system of government, or, rather, the absence of anything deserving the name of government. The aristocracy, by unjust taxation, persecution, and violence, extort from the agricultural population the small surplus of their earnings which remains after their absolute necessities are satisfied. Consequently the villages have a desolate appearance, the roads are execrable, and stagnation prevails throughout the country. Yet the peninsula is remarkably rich in natural products. The gold deposits must be of value, for, even now, gold-dust to the value of about £500,000 is exported yearly. There are rich mines of anthracite in the north, and iron, copper, and lead await the miner and manufacturer. But as long as abject poverty is a man's sole protection the country cannot make progress.

— An interesting article on the utilization of waste products in relation to breweries, in the *Brewers' Guardian* (English), calls attention to the utilization of the carbonic acid gas produced in the fermentation of sugar. On an average, English beer may be considered to contain 5 per cent of alcohol, and as, in the fermentation of sugar, the weight of carbonic acid produced is almost the same as that of alcohol (the exact proportions being 48.9 of carbonic acid to 51.1 of alcohol), there must have been 500,000,000 pounds of carbonic acid produced in our breweries. The specific gravity of carbonic acid is 0.1524, and therefore a simple calculation shows that the above weight is equal to 25,000,000,000 gallons — a volume it is almost impossible to realize. Such a volume would require a space one mile square and forty yards high to contain it. It is now proposed to utilize the greater portion of this large quantity of carbonic acid. The process by which this is to be done has been tried for some little time past in St. James's Gate brewery, Dublin; and Sir Charles A. Cameron has reported very favorably on it. The following are the conclusions at which he arrives after a most careful examination of the process: (1) An immense quantity of carbonic acid is produced in breweries, and is at present wasted; (2) a large proportion of this gas could be condensed to liquid at a cost not exceeding ½d. per pound, but probably less than ¼d. per pound; (3) the process of liquefying the gas is successfully carried on at Guinness's brewery, Dublin; (4) the liquefied gas prepared at Guinness's brewery is perfectly free from any peculiarity of flavor or odor; (5) the carbonic acid produced at soda-water works costs about 4d. per pound; (6) it is safer, and in every way more desirable, to use in beverages carbonic acid derived from a food substance, such as grain, than from mineral sources; (7) the uses of liquid carbonic acid are numerous, important, and increasing.

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RELATIONS OF TEMPERATURE TO VERTEBRÆ AMONG FISHES.[1]

It has been known for many years that in certain groups of fishes the northern or cold-water representatives have a larger number of vertebræ than those members which are found in tropical regions. To this generalization, first formulated by Dr. Gill in 1863, we may add certain others which have been more or less fully appreciated by ichthyologists, but which for the most part have never received formal statement. In groups containing fresh-water and marine members, the fresh-water forms have in general more vertebræ than those found in the sea. The fishes inhabiting the depths of the sea have more vertebræ than their relatives living near the shore. In free-swimming pelagic fishes the number of vertebræ is also greater than in the related shore fishes of the same regions. The fishes of the earlier geological periods have for the most part numerous vertebræ, and those fishes with the low numbers (24 to 26) found in the specialized spiny-rayed fishes appear only in comparatively recent times. In the same connection we may also bear in mind the fact that those types of fishes (soft-rayed and anacanthine) which are properly characterized by increased numbers of vertebræ predominate in the fresh waters, the deep seas, and in Arctic and Antarctic regions. On the other hand, the spiny-rayed fishes are in the tropics largely in the majority.

In the present paper, I wish to consider the extent to which these statements are true and to suggest a line of explanation which covers all these generalizations alike.

For the purpose of this discussion we may assume the derivation of species by means of the various influences and processes, for which, without special analysis, we may use the term "natural selection." By the influence of natural selection, the spiny-rayed fish, so characteristic of the present geological era, has diverged from its soft-rayed ancestry.

[1] Abstract of a paper by David Starr Jordan, president of Leland Stanford, Jr., University (Proceedings U.S. National Museum, XIV., 107).

The influences which have produced the spiny-rayed fish have been most active in the tropical seas. It is there that "natural selection" is most potent, so far as fishes are concerned. The influence of cold, darkness, monotony, and restriction is to limit the direct struggle for existence, and therefore to limit the resultant changes. In general the external conditions most favorable to fish life are to be found in the tropical seas, among rocks and along the coral reefs near the shore. Here is the centre of competition. From conditions otherwise favorable to be found in Arctic regions, the majority of competitors are excluded by their inability to bear the cold. In the tropics is found the greatest variety in surroundings, and therefore the greatest variety in the possible adjustments of series of individuals to correspond with these surroundings.

The struggle for existence in the tropics is a struggle between fish and fish, and among the individuals of a very great number of species, each one acquiring its own peculiar points of advantage. No form is excluded from competition. No competitor is handicapped by loss of strength on account of cold, darkness, foul water, or any condition adverse to fish life.

The influences which serve as a whole to make a fish more intensely and compactly a fish, and which tend to rid it of every character and every organ not needed in fish life, should be most effective along the rocks and shores of the tropics.

For this process of intensification of fish-like characters, which finds its culmination in certain specialized spiny-rayed fishes of the coral reefs, we may conveniently use the term "ichthyization."

If ichthyization is in some degree a result of conditions found in the tropics, we may expect to find a less degree of specialization in the restricted and often unfavorable conditions which prevail in the fresh waters, in the cold and exclusion of the polar seas, and especially in the monotony, darkness, and cold of the oceanic abysses where light can not penetrate and where the temperature scarcely rises above the freezing point.

An important factor in ichthyization is the reduction of the number of segments or vertebræ, and a proportionate increase in the size and complexity of the individual segment and its appendages. If the causes producing this change are still in operation, we should naturally expect that in cold water, deep water, dark water, fresh waters, and in the waters of a past geological epoch the process would be less complete and the numbers of vertebræ would be larger. And this, in a general way, is precisely what we find in the examination of a large series of fishes.

If this view is correct, we have a possible theory of the reduction in numbers of vertebræ as we approach the equator. It should, moreover, not surprise us to encounter various modifications and exceptions, for we know little of the habits and scarcely anything of the past history of great numbers of species. The present characters of species may depend on occurrences in the past concerning which even guesses are impossible.

It may be taken for granted that the ancestry of the various modern types of bony fishes is to be sought among the Ganoids. All the fossil forms in this group have a notably large number of vertebræ. The few now living are nearly all fresh-water fishes, and among these, so far as known, the numbers range from 65 to 110.

Among the *Teleostei* or bony fishes, those which first appear in geological history are the *Isospondyli*, the allies of the salmon and herring. These have all numerous vertebræ, small in size, and none of them in any notable degree modified or specialized. In the northern seas *Isospondyli* still exceed all other fishes in number of individuals. They abound in the depths of the ocean, but there are comparatively few of them in the tropics.

The *Salmonidæ* which inhabit the rivers and lakes of the northern zones have from 60 to 65 vertebræ. The *Scopelidæ*, *Stomiatidæ*, and other deep-sea analogues have from 40 upwards in the few species in which the number has been counted. The group of *Clupeidæ* is probably nearer the primitive stock of *Isospondyli* than the salmon are. This group is essentially northern in its distribution, but a considerable number of its members are found within the tropics. The common herring ranges farther into the Arctic regions than any other. Its vertebræ are 56 in number. In the shad, a northern species which ascends the rivers, the same number has been recorded.

The sprat and sardine, ranging farther south, have from 48 to 50, while in certain small herring which are strictly confined to tropical shores the number is but 40. Allied to the herring are the anchovies, mostly tropical. The northernmost species, the common anchovy of Europe, has 46 vertebræ. A tropical species has 41 segments. There are, however, a few soft-rayed fishes confined to the tropical seas in which the numbers of vertebræ are still large, an exception to the general rule for which there is no evident reason unless it be connected with the wide distribution of these almost cosmopolitan fishes. In a fossil herring-like fish from the Green River shales, I counted 40 vertebræ; in a bass-like or serranoid fish from the same locality 24, these being the usual numbers in the present tropical members of these groups.

The great family of *Siluridæ* or catfishes seems to be not allied to the *Isospondyli*, but a separate offshoot from another ganoid type. This group is represented in all the fresh waters of temperate and tropical America, as well as in the warmer parts of the Old World. One division of the family, containing numerous species, abounds on the sandy shores of the tropical seas. The others are all fresh-water fishes. So far as the vertebræ in the *Siluridæ* have been examined, no conclusions can be drawn. The vertebræ in the marine species range from 35 to 50; in the North American forms from 37 to 45, and in the South American fresh-water species, where there is almost every imaginable variation in form and structure, the numbers range from 28 to 50 or more.

The *Cyprinidæ*, confined to the fresh waters of the northern hemisphere, and their analogues, the *Characinidæ* of the rivers of South America and Africa, have also numerous vertebræ, 36 to 50 in most cases. I fail to detect in either group any relation in these numbers to surrounding conditions.

In general, we may say of the soft-rayed fishes that very few of them are inhabitants of tropical shores. Of these few, some which are closely related to northern forms have fewer vertebræ than their cold-water analogues. In the northern species, the fresh-water species, and the species found in the deep sea, the number of vertebræ is always large, but the same is true of some of the tropical species also.

Among the spiny-rayed fishes the facts are more striking. Of these, numerous families are chiefly or wholly confined to the tropics, and in the great majority of all the species the number of vertebræ is constantly 24, 10 in the body and 14 in the tail (10 + 14). In some families in which the process of ichthyization has gone on to an extreme degree, as in certain *Plectognath* fishes, there has been a still further reduction, the lowest number, 14, existing in the short inflexible body of the trunkfish, in which the vertebral joints are movable only in the base of the tail. In all these forms, the process of reduction of vertebræ has been accompanied by specialization in other respects. The range of distribution of these fishes is chiefly though not quite wholly confined to the tropics.

A very few spiny-rayed families are wholly confined to the northern seas. One of the most notable of these is the family of viviparous surf fishes, of which numerous species abound on the coasts of California extending to Oregon, and Japan, but which enter neither the waters of the frigid nor the torrid zone. These fishes seem to be remotely connected with the *Labridæ* of the tropics, but no immediate proofs of their origin exist. The surf fishes have from 32 to 42 vertebræ, numbers which are never found among tropical fishes of similar appearance or relationship.

The case of the *Labridæ*, in which the fact was first noticed, has been already mentioned. Equally striking are the facts in the great group of *Cataphracti*, or mailed-cheek fishes, a tribe now divided into several families, diverging from each other in various respects, but agreeing in certain peculiarities of the skeleton. Among these fishes the family most nearly related to ordinary fishes is that of *Scorpænidæ*. This is a large family containing many species, fishes of local habits, swarming about the rocks at moderate depths in all zones. The species of the tropical genera have all 24 vertebræ. Those genera chiefly found in cooler waters, as in California, Japan, Chili, and the Cape of Good Hope, have in all their species 27 vertebræ, while in the single arctic genus there are 31. An antarctic genus bearing some relation to *Sebastes* has 39.

Allied to the *Scorpænidæ*, but confined to the tropical or semitropical seas, are the *Platycephalidæ*, with 27 vertebræ, and the *Cephalacanthidæ*, with but 22. In the deeper waters of the tropics are the *Peristediidæ*, with 33 vertebræ, and extending farther north, belonging as much to the temperate as to the torrid zone, is a large family of the *Triglidæ*, in which the vertebræ range from 25 to 38.

The family of *Agonidæ*, with 36 to 40 vertebræ, is still more decidedly northern in its distribution. Wholly confined to northern waters is the great family of the *Cottidæ*, in which the vertebræ ascend from 30 to 50. Entirely polar and often in deep waters are the *Liparididæ*, an offshoot from the *Cottidæ*, with soft, limp bodies, and the vertebræ 35 to 65. In these northern forms there are no scales, the spines in the fins have practically disappeared, and only the anatomy shows that they belong to the group of spiny-rayed fishes. In the *Cyclopteridæ*, likewise largely arctic, the body becomes short and thick, the backbone inflexible, and the vertebræ are again reduced to 28. In most cases, as the number of vertebræ increases, the body becomes proportionally elongate. As a result of this, the fishes of arctic waters are, for the most part, long and slender, and not a few of them approach the form of eels. In the tropics, however, while elongate fishes are common enough, most of them (always excepting the eels) have the normal number of vertebræ, the greater length being due to the elongation of their individual vertebræ and not to their increase in number.

In the great group of blenny-like fishes the facts are equally striking. The arctic species are very slender in form as compared with the tropical blennies, and this fact, caused by a great increase in the number of their vertebræ, has led to the separation of the group into several families. The tropical forms composing the family of *Blenniidæ* have from 28 to 49 vertebræ, while in the arctic genera the numbers range from 75 to 100.

The anacanthine fishes in whole or in part seem to have sprung from a blennioid stock. Of these the most specialized group is that of the flounders (*Pleuronectidæ*), already described. The wide distribution of this family, its members being found on the sandy shores of the zones, renders it especially important in the present discussion. The other anacanthine families are chiefly confined to the cold waters or to the depth of the seas. In the cod family (*Gadidæ*) the number of vertebræ is usually about 50, and in their deep-sea allies, the grenadiers or rat-tails, the numbers range from 65 to 80.

Of the families confined strictly to the fresh waters, the great majority are among the soft-rayed or physostomous fishes, the allies of the salmon, pike, carp, and cat-fish. In all of these the vertebræ are numerous. A few fresh-water families have their affinities entirely with the more specialized forms of the tropical seas. Of these the *Centrarchidæ* (comprising the American fresh-water sun-fish and black bass) have on the average about 30 vertebræ, the pirate perch 29, and the perch family, perch and darters, etc., 35 to 45, while the *Serranidæ* or sea bass, the nearest marine relatives of all these, have constantly 24. The marine family of demoiselles (*Pomacentridæ*) have 26 vertebræ, while 30 to 40 vertebræ usually exist in their fresh-water analogues (or possibly descendants), the *Cichlidæ*, of the rivers of South America and Africa. The sticklebacks, a family of spiny fishes, confined to the rivers and seas of the north, have from 31 vertebræ to 41.

It is apparently true that among the free-swimming, or migratory pelagic fishes, the number of vertebræ is greater than among their relatives of local habits. This fact is most evident among the Scombriform fishes, the allies of the mackerel and tunny. All of these belong properly to the warm seas, and the reduction of the vertebræ in certain forms has no evident relation to the temperature, though it seems to be related in some degree to the habits of the species. Perhaps the retention of many segments is connected with that strength and swiftness in the water for which the mackerels are pre-eminent.

The variations in the number of vertebræ in this group led Dr. Günther, nearly thirty years ago, to divide it into two families, the *Carangidæ* and *Scombridæ*. The *Carangidæ* are tropical shore fishes, local or migratory to a slight degree. All these have from 24 to 26 vertebræ. In their pelagic relatives, the dolphins, there are from 30 to 33; in the opahs, 45; in the brama, 42; while the great mackerel family, all of whose members are more or less pelagic, have from 31 to 50. Other mackerel-like fishes are the cutlass fishes, which approach the eels in form and in the reduction of the fins. In these the vertebræ are correspondingly numerous, the numbers ranging from 100 to 160. In apparent contradistinction to this rule, however, the pelagic family of sword-fishes, remotely allied to the mackerels, and with even greater powers of swimming, has the vertebræ in normal number, the common sword-fish having but 24.

The eels constitute a peculiar group of uncertain but probably soft-rayed ancestry, in which everything else has been subordinated to muscularity and flexibility of body. The fins, girdles, gill arches, scales, and membrane bones are all imperfectly developed or wanting. The eel is perhaps as far from the primitive stock as the most highly ichthyized fishes, but its progress has been of another character. The eel would be regarded in the ordinary sense as a degenerate type, for its bony structure is greatly simplified as compared with its ancestral forms, but in its eel-like qualities it is, however, greatly specialized. All the eels have vertebræ in great numbers. As the great majority of the species are tropical, and as the vertebræ in very few of the deep-sea forms have been counted, no conclusions can be drawn as to the relation of their vertebræ to the temperature.

It is evident that the two families most decidedly tropical in their distribution, the morays and the snake-eels, have diverged farthest from the primitive stock. They are most "degenerate," as shown by the reduction of their skeleton. At the same time they are also most decidedly "eel-like," and in some respects, as in coloration, dentition, muscular development, most highly specialized. It is evident that the presence of numerous vertebral joints is essential to the suppleness of body which is the eel's chief source of power. So far as known, the numbers of vertebræ in eels range from 115 to 160, some of the deep-sea eels having probably higher numbers, if we can draw inferences from their slender or whip-like forms; but this character may be elusive.

The sharks show likewise a very large number of vertebræ, 130 to 150 in the species in which they have been counted. In these fishes no comparative study of the vertebræ has been made. The group is a very ancient one in geological time, and in the comparatively few remaining members of the group, the vertebræ, in fact the entire skeleton, is in a very primitive condition. The sharks are free-swimming fishes, and with them as with the eels, flexibility of body is essential to the life they lead.

In some families the number of rays in the dorsal and anal fins is dependent on the number of vertebræ. It is therefore subject to the same fluctuations. This relation is not strictly proportionate, for often a variable number of rays with their interspinal processes will be interposed between a pair of vertebræ. The myotomes or muscular bands on the sides are usually coincident with the number of vertebræ. As, however, these and other characters are dependent on differences in vertebral segmentation, they bear the same relations to temperature that the vertebræ themselves sustain.

From the foregoing examples we may conclude that, other things being equal, the numbers of vertebræ are lowest in the shore-fishes of the tropics, and especially in those of local habits, living about rocks and coral reefs. The cause of this is to be found in the fact that in these localities the influences of natural selection are most active. The production of vertebræ may be regarded as a phase in the process of specialization which has brought about the typical spiny-rayed fish.

These influences are most active in the warm, clear waters of tropical shores, because these regions offer conditions most favorable to fish-life, and to the life of the greatest variety of fishes. No fish is excluded from competition. There is the greatest variety of competitors, the greatest variety of fish-food, and the greatest variety of conditions to which adaptation is possible. The number of species visiting any single area is vastly greater in the tropics than in cold regions. A single drawing of the net on the shores of Cuba will obtain more different kinds of fish than can be found on the coasts of Maine in a year. Cold, monotony, darkness, isolation, foul water,—all these are characters opposed to the formation of variety in fish-life. The absence of these is a chief feature of life in the tropical waters.

The life of the tropics, so far as the fishes are concerned, offers analogies to the life of cities, viewed from the standpoint of human development. In the same way, the other regions under consideration are, if we may so speak, a sort of ichthyological backwoods. In the cities, in general, the conditions of individual existence are most easy, but the competition is most severe. The struggle for existence is not a struggle with the forces and conditions of nature. It is not a struggle with wild beasts, unbroken forests, or a stubborn soil, but a competition between man and man for the opportunity of living.

It is in the cities where the influences which tend to the modernization and concentration of the characters of the species, the intensification of human powers and their adaptation to the various special conditions, go on most rapidly. That this intensification is not necessarily progress, either physically or morally, is aside from our present purpose.

It is in the cities where those characters and qualities not directly useful in the struggle for existence are first lost or atrophied. Conversely it is in the "backwoods," the region most distinct from human conflicts, where primitive customs, antiquated peculiarities, and useless traits are longest and most persistently retained. The life of the backwoods will be not less active and vigorous, but it will lack specialization.

It is not well to push this analogy too far, but we may perhaps find in it a suggestion as to the development of the eels. In every city there is a class which partakes in no degree of the general line of development. Its members are specialized in a wholly different way, thereby taking to themselves a field which the others have abandoned, and making up in low cunning what they lack in strength and intelligence. Thus among the fishes we have in the regions of closest competition a degenerate and non-ichthyized form, lurking in holes among rocks and creeping in the sand, thieves and scavengers among fishes. The eels fill a place which would otherwise be left unfilled. In their way, they are perfectly adapted to the lives they lead. A multiplicity of vertebral joints is useless to the typical fish, but to the eel strength and suppleness are everything, and no armature of fin or scale or bone so desirable as its power of escaping through the smallest opening.

It may be too that, as rovers in the open sea, the strong swift members of the mackerel family find a positive advantage in the possession of many vertebræ, and that to some adaptation to their mode of life we must attribute their lack of ichthyization of the skeleton. But this is wholly hypothetical, and we may leave the subject with the general conclusion that with the typical fish advance in structure has specialized the vertebræ, increased their size and the complexity of their appendages, while decreasing their numbers; and that, with some exceptions and modifications, this reduction is characteristic of fishes in the tropics, and that it is so because in the tropics the processes of evolution are most active, so far as the fishes are concerned.

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.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Fair-Weather Echoes.

MY dog, a deep-voiced Newfoundlander, has one plague in life — an echo. It comes from a cottage some three hundred yards off, and there that "other dog" will always have the last word. This is exasperating, and "Graph"—he is named after another sound-producer, the graphophone — gives vent to his anger in a series of short, sharp, threatening yelps, which are of course more distinctly reproduced than the long bow-wows and howls. Last night Graph was very noisy, but the echo was silent. I tried to rouse it, and excited Graph to do his utmost, but with no effect. A moderate, even-down rain was falling, and the fair-weather echo would not venture out. There is, of course, a reason for this, but I had never noticed the fact before. Is the explanation that the lines of rain cut through the aerial sound-waves and stop them? Are echoes among the hills interfered with by rain?

When the shower was over I tested the echo again, and there it was, a little fainter than usual, but persistent as ever.

A. M. B.

Colonial Beach, Va., Aug. 13.

Number of Words in an Ordinary Vocabulary.

IN examining the vocabularies of children, my interest in the size and nature of the vocabulary of an ordinary person, previously aroused by the varying statements and estimates I have seen, was excited sufficiently to induce me to spend a portion of my vacation in making some investigations, the results of which may be of interest to the readers of *Science*.

I first turned to Webster's Unabridged Dictionary (edition of 1870), and counted the words on every twenty-fifth page, and found the percentage of them whose meaning was known to me. Then by calculation I found that if the same percentage holds for the other pages I must know the meaning of nearly seventy thousand of the words given in that edition of the dictionary. Since in the dictionary a word as a transitive verb, as an intransitive verb, as a noun, as an adjective, as an adverb, is separately defined, as well as when used with a prefix, a suffix, or in a compound; and since the irregular plurals, adjectives irregularly compared, and the parts of irregular verbs are also given, this number is perhaps twice that of the really different words. The meaning of some of these words was readily divined from their form, although they had never been seen. On the other hand, one word not unfrequently has a dozen different shades of meaning, several of which often require as different and definite associations as entirely distinct words. Hence the effort required to learn all of these words, with their different shades of meaning, but similar form, is probably as great as it would be to have seventy thousand different words, each having but one meaning. I did not understand the meaning of all of the words well enough to define and use them with accuracy, but merely well enough to grasp their meaning in any sentences in which they might be used, and I probably have never actually used a fourth of them. But, besides the words in the dictionary and some new words given in later editions, and a number of words and phrases from other languages in common use, there are probably several thousand proper names, such as are found in history, geography, fiction, and among acquaintances, each with its distinct associations, familiar to every intelligent person. These words will more than make up for any error in counting that I could have made.

Professor E. S. Holden (Trans. Philol. Soc., 1877), found his own vocabulary to be between thirty-three and thirty-four thousand words, and estimated that of an ordinarily intelligent person at twenty-five thousand. I do not know what he called a word, nor whether he counted as known words that he could not or did not use. He estimates that the vocabulary of technical terms possessed by a specialist may reach ten thousand or more. In "Gray's Structural Botany" there is a glossary of between two and three thousand technical terms, the vast number used in cryptogamic botany not being included in the list, and of course none of the special names of plants, so it is not improbable that a well-read botanist may have a technical vocabulary of ten thousand words, and a zoologist a greater number.

The words in common use by the ordinary individual has been estimated at from one to three thousand, and it is claimed that when one has learned the meaning of that many words he can carry on any ordinary conversation or understand common, general reading. It is also frequently stated that the vocabulary of certain miners consisted of but one hundred words. Whether this was an actual count or merely an estimate I do not know, but should think that it must be the latter. In order to determine the size of an ordinary vocabulary I could think of no better means than to find out the number of words used in some standard work that is easily read and understood by everybody. Nor could I think of any book better suited for the purpose in view than that great English classic, "Robinson Crusoe." The copy of that work in my possession contains 460 pages, and I first noted down all of the different words found on every tenth page (counting as a separate word what is given as such in the dictionary). This probably gave more different words than forty-six consecutive pages would have done, because a greater number of subjects and incidents are discussed and described. I then noted the new words on the remaining nine of a section of ten pages in the front part of the book, and then of a section in the latter part, in order to get a basis for estimating the new words in the rest of the book. The number of words on the sixty-four pages counted was thirty-one hundred, and if the percentage of decrease for each section of nine pages from the section counted just before it should be the same as for the two sections counted, there would be on the remaining 396 pages about three thousand words. It may be, as would seem probable, that the percentage of decrease would increase after awhile, but so far as counted there was no sign of an increased rate of falling off. The falling off was very rapid for the first five pages, less rapid for the next twenty, and after that not enough to be evident unless the average of a number of pages was taken. It seems quite certain, then, that De Foe, in writing his account of the adventures of Robinson Crusoe, used not less than five or six thousand words. Children of ten or twelve years read the book with pleasure, and probably have a pretty clear idea of the meaning of nine out of ten of the words they find in it. The work probably contains most of the verbs and a large proportion of the adjectives and adverbs in common use, but there is a large number of nouns, both common and proper, familiar to every child, which De Foe had no occasion to use in this work. It is probable then that to read ordinary general reading in English understandingly one needs to be familiar with from six to ten thousand words. The same must be true for other languages equally rich in synonymes. Grimm's "Märchen" contains a vocabulary of between four and five thousand words, yet any one who can readily read those stories needs a dictionary constantly by his side when reading ordinary German.

From the data at hand I should estimate the vocabulary of a citizen of the United States with a common-school education and of ordinary intelligence and reading at about ten thousand words, and that of a well-read college graduate, and of those who have pursued a university course, at from twenty thousand upwards to perhaps one hundred thousand. One's vocabulary is usually nearly complete at thirty years of age. If but two words are learned each day the vocabulary at that age would be only twenty thousand. My records show that young children acquire new words more rapidly than that.

As to the composition of a vocabulary, I find that in the dictionary about 60 per cent of the words are nouns, a little over 22 per cent adjectives, and a half that per cent verbs, and a fourth adverbs. Pronouns, prepositions, and conjunctions, though used in every sentence, constitute a very small part of a general vocabulary — none were found in examining fifteen pages, or one in every hundred, in the dictionary. Of the thirty-one hundred words obtained from "Robinson Crusoe," a little over 45 per cent were nouns, 24 per cent verbs, a little over 17 per cent adjectives, and 7 per cent adverbs. Probably nearly every one is familiar with a larger proportion of the verbs than of the nouns in the dictionary, but "Robinson Crusoe" is particularly rich in verbs. Many of them are used only as participles, the form in many cases being the same as for the adjectives, but they only counted as verbs unless distinctively used as adjectives. As already suggested, the ordinary vocabulary contains a larger proportion of nouns than are found in "Robinson Crusoe," and many that are not found in the dictionary, although the proportion is probably not greatly different from what it is in the latter. In small vocabularies the proportion for the different parts of speech is quite different. Of the 215 words on the first page of "Crusoe" that I counted, 5 per cent were prepositions, 10 per cent adverbs, 10 per cent pronouns, 6 per cent conjunctions, and but 24 per cent nouns. This must be borne in mind in considering small vocabularies like those of children.

As a matter of some general interest, and a point of considerable importance, in considering the question of the pronouncing vocabulary of children, it is worth while to notice with what letters of the alphabet the greatest number of words begins. The letters s, p, and c begin nearly one-third of the words in the English language. The following is the order for the letters most frequently used in the dictionary: s, p, c, a, t, b, r, m, d, f, e, h, l, g, w, o, v, n, u; in "Robinson Crusoe," s, c, p, a, f, b, r, m, e, t, w, h, l, i, g, o, n, u, v.

Further data are needed in order to confirm or correct the estimates given in this article. E. A. KIRKPATRICK.

Rhodes, Iowa, Aug. 14.

Climatic Changes in the Southern Hemisphere.

HAVING had occasion to cruise a considerable time over the Southern Ocean, I have had my attention directed to its prevailing winds and currents, and the way in which they affect its temperature, and also to the ice-worn appearance of its isolated lands.

It is now generally conceded that the lands situated in the high latitudes of the southern hemisphere have in the remote past been covered with ice-sheets, similar to the lands which lie within the antarctic circle. The shores of southern Chili, from latitude 40° to Cape Horn, show convincing evidence of having been overrun by heavy glaciers, which scoured out the numerous deep channels that separate the Patagonian coast from its islands. The Falkland Islands and South Georgia abound with deep friths; New Zealand and Kerguelen Land also exhibit the same evidence of having been ice-laden regions; and it is said that the southern lands of Africa and Australia show that ice accumulated at one time to a considerable extent on their shores. At this date we find the southern ice-sheets mostly confined to regions within the antarctic circle; still the lands of Chili, South Georgia, and New Zealand possess glaciers reaching the low lands, which are probably growing in bulk; for it appears that the antarctic cold is slowly on the increase, and the reasons for its increase are the same as the causes which brought about the frigid period which overran with ice all lands situated in the high southern latitudes.

Why there should be a slow increase of cold on this portion of the globe is because of the independent circulation of the waters of the Southern Ocean. The strong westerly winds of the southern latitudes are constantly blowing the surface waters of the sea from west to east around the globe. This causes an effectual barrier, which the warm tropical currents cannot penetrate to any great extent. For instance, the tropical waters of the high ocean levels, which lie abreast Brazil in the Atlantic and the east coast of Africa in the Indian Ocean, are not attracted far into the southern sea, because the surface waters of the latter sea are blown by the westerly winds from west to east around the globe. Consequently the tropical waters moving southward are turned away by the prevailing winds and currents from entering the Southern Ocean. Thus the ice is accumulating on its lands, and the temperature of its waters slowly falling through their contact with the increasing ice; and such conditions will continue until the lands of the high southern latitudes are again covered with glaciers, and a southern ice period perfected. But while this gathering of ice is being brought about, the antarctic continent, now nearly covered with an ice-sheet, will, through the extension of glaciers out into its shallow waters, cover a larger area than now; for where the waters are shoal the growing glaciers, resting on a firm bottom, will advance into the sea, and this advancement will continue wherever the shallow waters extend. Especially will this be the case where the snowfall is great.

Under such conditions, it appears that the only extensive body of shallow water extending from the ice-clad southern continent is the shoal channel which separates the South Shetlands from Cape Horn, which is a region of great snowfall. Therefore should the antarctic ice gain sufficient thickness to rest on the bottom of this shallow sea it would move into the Cape Horn channel and eventually close it. The ice growth would not be entirely from the southern continent, but also from lands in the region of Cape Horn. Thus the antarctic continent and South America would be connected by an isthmus of ice, and consequently the independent circulation of the Southern Ocean arrested. Hence it will be seen that the westerly winds, instead of blowing the surface waters of the Southern Ocean constantly around the globe, as they are known to do to-day, would instead blow the surface waters away from the easterly side of the ice-formed isthmus, which would cause a low sea-level along its Atlantic side, and this low sea-level would attract the tropical waters from their high level against Brazil well into the southern seas, and so wash the antarctic continent to the eastward of the South Shetlands.

The tropical waters thus attracted southward would be cooler than the tropical waters of to-day, owing to the great extension of cold in the southern latitudes. Still they would begin the slow process of raising the temperature of the Southern Ocean, and would in time melt the ice in all southern lands. Not only the Brazil currents would penetrate the southern seas, as we have shown, but also the waters from the high level of the tropical Indian Ocean which now pass down the Mozambique Channel would reach a much higher latitude than now.

The ice-made isthmus uniting South America to the antarctic continent would, on account of its location, be the last body of ice to melt from the southern hemisphere, it being situated to the windward of the tropical currents and also in a region where the fall of snow is great; yet it would eventually melt away, and the independent circulation of the Southern Ocean again be established. But it would require a long time for ice-sheets to again form on southern lands, because of the lack of icebergs to cool the southern waters. Still, their temperature would gradually lower with the exclusion of the tropical waters, and consequently ice would slowly gather on the antarctic lands.

The above theory thus briefly presented to account for the climatic changes of the high southern latitudes is in full accord with the simple workings of nature as carried on to-day; and it is probable that the formation of continents and oceans, as well as the earth's motions in its path around the sun, have met with little change since the cold era iced the lands of the high latitudes.

At an early age, previous to the appearance of frigid periods, the ocean waters of the high latitudes probably did not possess an independent circulation sufficient to lower the temperature so that glaciers could form. This may have been owing to the shallow sea-bottom south of Cape Horn having been above the surface of the water, the channel having since been formed by a comparatively small change in the ocean's level. For, while considering this subject, it is well to keep in mind that whenever the western continent extended to the antarctic circle it prevented the independent circulation of the Southern Ocean waters, consequently during such times ice periods could not have occurred in the southern hemisphere.

It will be noticed that according to the views given above, the several theories which have been published to account for great climatic changes neglect to set forth the only efficacious methods through which nature works for conveying and withdrawing tropical heat sufficient to cause temperate and frigid periods in the high latitudes. While lack of space forbids an explanation of the causes which would perfect an ice period in the northern hemisphere, I will say that it could be mainly brought about through the independent circulation of the arctic waters, which now largely prevent the tropical waters of the North Atlantic from entering the arctic seas, thus causing the accumulation of ice sheets on Greenland. But before a northern ice period can be perfected, it seems that it will need to co-operate with a cold period in the southern hemisphere; and in order to have the ice of a northern frigid period melt away, it would require the assistance of a mild climate in the high southern latitudes.

C. A. M. TABER.

Wakefield, Mass., Aug. 14.

BOOK-REVIEWS.

The Journal of the College of Science, Imperial University of Japan. Vol. IV., Part I.

THIS volume forms a fitting complement to the numbers already issued, and indicates the advanced position of the college and the high standing of its teachers and special students. If any thing would commend an institution to the generous attention of the government it is the admirable work which has been embodied in the various memoirs of the series. The present number opens with a memoir by Professor K. Mitsukuri on the "Fœtal Membranes of Chelonia." It is one of a series on the embryology of *Reptilia.* The first one, in which Mr. Ishikawa was joint author, was on the germinal layers of Chelonia. The fœtal membranes of *Reptilia* have been supposed to bear a close resemblance to those of birds. Mr. Mitsukuri has found many notable features which have, hitherto, been overlooked, and these appeared so remarkable that he has made them the subject of his memoir. Ten beautiful plates accompany the text.

Mr. Kamakichi Kishinouye gives the results of his researches on the "Development of the Araneina," illustrated by four plates. The material for study was obtained on the grounds of the university, and this included *Lycosa*, *Agalina*, and other genera of spiders. His method of treating the eggs is given in full, and will be found of great value to the student. His discussion of the formation of the pulmonary lamellæ or lung-book is very interesting. He thinks it probable that the lung-book was derived from the gills of some aquatic arthropodous animal, such as Limulus, comparing it with the lamellar branchia of Limulus sunk beneath the body surface. He shows that an invagination of the first abdominal appendage gives rise to the lung-book, and a similar invagination at the base of the second gives rise to a tube—abortive trachea. Many other interesting points are developed or sustained in this memoir.

Mr. Oka has a memoir on a new species of fresh-water polyzoa, *Pectinatella gelatinosa.* His methods of preparation will be found valuable to students of this group. His allusions to the views of Hyatt and Morse as to the anterior region of the polypidæ refer to views uttered over twenty-five years ago, when the polyzoa and brachiopods, with the tunicates, were supposed to be molluscan. These views are antiquated, and have long since been abandoned by the authors in question. Circulation is showed by Oka to be by ciliary action. He confirms Verworn in showing ciliary action on the external wall of the alimentary canal. Important observations are made on a pair of excretory organs which are ciliated and communicate with the epigastric cavity by wide openings. Their external openings have not been found, but the relation these bear to the segmental organs of brachiopods and worms seems unquestionable. An exhaustive discussion is given to the development of the statoblast, and the longitudinal sections depicted are of great value. The memoir is a solid contribution to the literature of this interesting group of animals. Four plates illustrate the details of anatomy and development.

Mr. Seitaro Goto has a memoir, with three plates, on a new form of Diplozoon, to which he gives the specific name of "nipponicum." He gives reasons for separating it from the single species known as paradoxum. The curious creature is described in detail, and interesting points are added to what has already been known.

A new species of hymenomycetous fungus injurious to the mulberry tree, illustrated by four plates, is described by Mr. Nobujiro Tanaka, with a discussion of this fungus, which has caused much destruction of the mulberry tree in Japan.

Notes on the irritability of the stigma, by Mr. Miyoshi, are illustrated by two plates. The author shows conclusively that this irritability, as Hermann Müller first suggested, has to do with the cross-fertilization of the flower, and is not for protection against wind and rain. Irritability is excited by an insect or a bristle, and not by a drop of water or by blowing against it.

Notes on the development of the suprarenal bodies in the mouse, with two plates, are by Mr. Masamaro Inaba. In this paper is discussed the mode of origin of the two substances which go to make up the suprarenal bodies. He comes to the conclusion that the cortical cells are derived from the peritoneal epithelium, as stated by Janosik; and the medullary substance from the sympathetic elements, as described by Professor Mitsukuri.

In these various memoirs the authors express their indebtedness to Professors Mitsukuri, Iijima, and Yatabe for aid and advice. The plates are marvels of beautiful lithography, and the drawings are made with that skill and accuracy which characterize all their work.

Taxidermy and Zoölogical Collecting. By WILLIAM T. HORNADAY. New York, Scribner. 8°. $2.50.

WHO the author of this work is, is certainly well known to most of the readers of *Science*. For years he has been connected with the National Museum as the chief taxidermist, and for a long time previously he was the taxidermist of a prominent natural science establishment. So it is with regret that we learn that Mr. Hornaday is to retire entirely from taxidermy forever. But associated with the chief author of the book was Dr. W. J. Holland, who supplied the chapters on collecting and preserving insects.

The considerable popular interest in zoölogy, and the great numbers of young naturalists coming forward, give reason to suppose that the book will meet with a considerable demand, especially as there is no other book of equal scope available.

The author urges on those who care for the preservation of specimens of many forms of animal life that they must be up and doing. It is already too late to collect wild specimens of the American bison, California elephant seal, West Indian seal, great auk, and Labrador duck. Very soon it will be impossible to find walrus, manatee, fur seal, prong-horn antelope, elk, moose, mountain sheep, and mountain goat. Then ducks are being rapidly exterminated for market, and numerous birds for the sake of fashion.

The first part of the book is on collecting and preserving. This is by no means an unimportant part of the whole, occupying nearly one hundred pages, and covers every part of the work of collecting zoological specimens, even to birds' eggs and nests.

Taxidermy is treated in the second part, which occupies one hundred and fifty pages. This opens with an account of the worker's laboratory, and closes with hints as to the most effective ways of "making up" the finished specimen, for they must resort to paint as well as some other faded beauties.

There are then a number of pages devoted to the making of plaster casts. This makes the third part of the book, which is followed by the part (IV.) devoted to osteology, or at least so much of it as can be applied in the collecting and mounting of skeletons.

The closing chapters are on insect collecting, by Dr. Holland. The book is liberally illustrated, credit being given by the author to Mr. Frederick A. Lucas for much assistance in this feature.

AMONG THE PUBLISHERS.

THE *Chautauquan* for September presents the following among other articles in its table of contents. "Russia and the Russians," by Mrs. C. R. Corson (illustrated); "The American Association for the Advancement of Science," by Marcus Benjamin; "What

Shall the Boy Take Hold of?" by Theodore Temple; "Modern Methods of Social Reform," by Lyman Abbott; "The United States as a Publisher of Scientific Books," by J. Howard Gore; "The Hawaiians," by Professor J. N. Ingram; and "Washington a Literary Centre," by Ellen Hardin Walworth.

— W. B. Harison of 3 East 14th Street, New York, announces the fifth edition of "A Manual of Land Surveying," by F. Hodgman and C. F. R. Bellows. This handy pocket volume of nearly five hundred pages contains, besides an elementary course of practice with instruments, a treatise upon the survey of public and private lands, and is adapted to the use of schools us well as of surveyors.

— D. C. Heath & Co., Boston, will issue this month "Folk and Fairy Tales in French for Young or Old Children," selected and edited, with notes and vocabulary, by Professor E. S. Joynes of the University of South Carolina. The edition will contain a number of favorite fairy tales by Perrault, Mme. d'Aulnoy, etc., offering easy and entertaining reading, with notes and vocabulary. They will also issue this month Andersen's "Bilderbuch ohne Bilder," an illustrated edition, with notes and vocabulary, by Dr. Wilhelm Bernhardt.

— Ginn & Co. announce "Talks with Young People about the Wonders of the Heavens," by Sir Robert S. Ball, F.R.S., Royal Astronomer of Ireland, illustrated. This book is based upon two courses of Christmas lectures delivered to children at the Royal Institution, Great Britain, and presents the fundamental facts and ideas of astronomy.

— The recently completed fifth edition of Dr. M. Foster's well-known "Text-Book of Physiology" will be followed at once by the appearance of a sixth and cheaper edition of the work, in parts, carefully revised throughout by the author. The addition of much new matter to this edition of the book will permit of taking out a copyright on the American edition, which is to be published by Macmillan & Co., New York.

SCIENCE

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First inserted June 19. No response to date.

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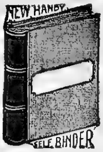

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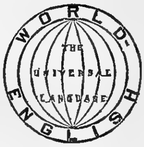

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SCIENCE

NEW YORK, AUGUST 28, 1891.

ALCHEMY.[1]

When I announce alchemy as the subject of my address, a word of apology is due for selecting a subject so outgrown and alien to the spirit of the age. It is not to revive the wild theories and chimerical hopes of the past that alchemy is brought before you at this hour. Yet it is always interesting to trace the evolution of a science, and to note its unfolding and progressive development, like the breaking of the morning. The dawn reveals wild shapes and distorted forms, the shadows of sunrise stretch out limitless, but with the onward sweep toward full day, portentous forms and endless shadows settle down to the safe and quiet realities of every-day life. So the wild dreams of that dawn of science have subsided into the assured facts of chemical science. Alchemy is often called the forerunner of chemistry, and out of its broken columns there has been built up the enduring temple of chemical science. No science has a more enduring basis of known facts than chemistry, and none can more calmly examine the basic principles upon which it is built without fear that the foundation stones will turn to dust upon the touch of investigation.

But no science comes to us like Minerva leaping from the brain of Jupiter,— "adult and full armed," — possibly because Jupiters are so rare, and the bold surgery of Vulcan so seldom invoked. The passage from alchemy to chemistry is full of suggestions, and has often been considered, but usually by contrast rather than comparison. One filled the world with vast hopes but unsatisfied longings; the other has crowned the race with benefactions. Yet the results of the labors and discoveries of the alchemists have been of great value to the world, even though the direct objects they sought forever eluded their grasp and left disappointment and despair to their votaries. More than a hundred years ago Harris tersely described alchemy, "Ars sine arte, cujus principium est mentiri, medium laborare, et finis mendicare," — the art without art, whose beginning is to lie, the middle to toil, and the end to beg.

We are prone to look back upon this nebulous science with disdain as the product of an age that had full confidence in magic and sorcery, that could accept without hesitation the elusive nature of matter, yet find no difficulty in the belief in the resistless power of occult forces. But let us be candid even in our review of ancient error. Let us see what were the hopes and aspirations of these hermits of science, and see how modern thought stands related to ancient dreams — whether we find in scientific thought, the same as in matter, a tendency to move in recurring cycles.

The objective points of the alchemists were:

1. *The Elixir of Life*, panacea, all-cure, a substance which would confer quasi-immortality upon any one who should swallow it, curing all sickness, assuaging all pain, and transforming hoary age into blooming youth. It was even more eagerly sought than the transmutation of metals. Life is the highest gift, and without it all other blessings turn to ashes. "All that man hath will he give for his life." But the crowning of life is health. It is not wonderful therefore that men in all ages have sought under various names the elixir of life.

The alchemists regarded gold as the king of metals, and its symbol was the sun — the giver of light and life. When the Spaniards discovered such astonishing quantities of gold in America, they were confident that some form of the elixir of life was hidden away somewhere in the mysterious continent, and many parties were formed to explore its solitudes in quest of this great gift. For this, Ponce de Leon and his faithful band pierced the swamps of Florida, seeking "the fountain of youth," where their leader was wounded to his death. But these were only the vanguards of a countless host that is still marching on.

The alchemists regarded gold as the most perfect form of matter; unalterable by fire, incorrodible by air, water, or any simple acid. Its very insolubility was proof of its excellence. This perfection of matter must be able to impart its properties to perishable forms of matter, and "potable gold" was supposed to be the elixir of life.

Roger Bacon was convinced that auric chloride was this elixir, and he informed Pope Nicholas IV. of the case of an old farmer in Sicily who ploughed up a golden vial containing a yellow liquid, which he swallowed supposing it to be dew, whereupon he was transformed into a vigorous youth.

Others sought the elixir as an essence derived from the distillation of a great number of substances, while the Hindoos supposed the Amreeta was obtained by churning the sea with a mountain.

We smile with superior air at such fantastic imaginings, yet not long ago the world went wild over Brown-Sequard's elixir of life,— extract of mutton.

2. *The Alcahest.* — The alchemists searched for some substance that would dissolve all other substances — alcahest, or universal solvent. Crookes forcibly suggests that this is found in fluorine.

3. *The Philosopher's Stone*, having the same purifying and ennobling office for mineral matter that the elixir of life would have on animal forms. By means of this substance they could effect the transmutation of base metals into perfect metals, "curing them of their sickness and perfecting their nature," thus changing copper to gold and lead to silver, performing "the great work" by projection of the philosopher's stone on base metals in presence of great heat.

Such were the dreams, the hopes, and the endeavors of the alchemists — life prolonged at pleasure, health perennial, wealth beyond measure. It was a great hope, and it was slow to die. The things sought are indissolubly interlinked with the desires if not the expectations of humanity. Nothing debasing entered into this scheme, but rather the aim was to ennoble man and matter, and out of base material to bring forth the flower and fruit of perfection. To a degree, man would become a creator, and a semblance of omnipotence would be placed in the hands of mortals, not merely

[1] Abstract of an address before the Section of Chemistry of the American Association for the Advancement of Science, at Washington, D.C., Aug. 19-25, 1891, by R. C. Kedzie, vice-president of the section.

by linking himself with the powers of nature and clothing himself with their immeasurable might, but by subduing these forces and compelling them to surrender their secrets and do his bidding. By torture nature could be taught to obey, and become the slave of her mortal child, and the crucible became the instrument and symbol of this power.

If the hope of such mastery and of victory laden with so rich spoils were held out to the children of the nineteenth century would they exhibit a superiority to the visionaries of the thirteenth century? It was the gambling spirit of the olden time, and man sought to use loaded dice in his game with nature.

Consider, also, how slowly the dreams of alchemy have given place to the wide-awake facts of chemistry. The great Napoleon, during his campaign in Egypt, sought initiation into the dark mysteries of Egyptian secret art. Napoleon III., before he ascended the French throne, had in his service those who attempted the transmutation of baser metals into gold. Dumas thought gold might be an allotropic form of copper, and silver allotropic lead; and Sir Humphrey Davy told the elder D'Israeli that he did not consider the undiscovered art of transmutation an impossible thing.

About three years ago, in a neighboring city, an alchemist exhibited to a leading business man his ability to multiply gold by heating a gold coin with the philosopher's stone in a crucible, and removing from the crucible a mass of gold weighing three times as much as the original coin. Other business men witnessed a similar operation, and became so fully convinced of his power to increase the amount of gold threefold that they formed a company to multiply gold by digestion with the philosopher's stone. Gold coin to the amount of ninety thousand dollars was placed in an iron digestion vat with a quantity of the philosopher's stone. The vat was placed over a fire in a furnace built for the purpose, an iron lid placed over the vat, and securely locked, the furnace-room locked, and all the keys placed in the hands of the gold-multiplying company (unlimited), with strict orders that the vat must not be opened under three weeks. The alchemist having been called away on business to another city, and not returning at the appointed time, the gold company became suspicious and opened the vat, only to find the gold gone, and some stones and scrap iron in its place. It was the *gold* that had been transmuted.

A few months ago the same sharper was arrested in London for attempting a similar fraud, and when arraigned in the criminal court the police magistrate said "it was just possible that Pinter might have discovered some method of increasing the weight of gold." Among the victims of Pinter's philosopher's stone, a member of the house of Rothschild's and of Baring Brothers are mentioned. Who shall say that faith in "the great work" has left the earth? A few days ago at the Old Bailey he was sent to prison for swindling.

The ancients, arguing from analogy, supposed that metals grew like vegetables, only the growth was subterranean; and there was a vain search for the seeds of metals. Foiled in this quest, they thought that metals passed upward by successive development by a sort of evolution, the base metals being progressively changed to those of a higher order till perfect metal such as gold was formed. A third conception was that metals are composite, made up of some basic matter or earth, and phlogiston. The notion of the composite character of a metal was perhaps the most damaging error of the alchemists. With them a metal was not a simple body, but the union of an earth with an inflammable matter; that the metalline character resided in the phlogiston rather than in the earth; that the greater the quantity of phlogiston combined with the earth the more perfect was the metalline character brought out, and if we could combine enough phlogiston with any earthy body we could form metals even of the most perfect character. Even Macquer, in his dictionary of chemistry (1776), is in doubt whether the kind of earth determines the character of the metal to be formed by adding phlogiston, and whether the real difficulty did not lie in securing sufficient phlogistication of intractable earths.

The perfect metal, gold, was considered to have an oily or unctuous quality, and the fact that oils contained a large amount of phlogiston was considered significant. To secure the oily quality of a perfect metal, oils were favorite sources of phlogiston; and it was claimed that if intractable earths were fused with oil in an accurately closed vessel, perfect metals could be secured. Nor was this mere theory. Beccher proposed to the States General to procure gold from any kind of sand, and claimed to demonstrate the same by his famous experiment of *Minera arenaria perpetua*, building his house on the sand very literally. So Beccher and Geoffroy proposed to obtain iron from all clays by heating them with linseed oil in close vessels.

The alchemists reasoned that if phlogiston were accepted as the metalliferous principle, the combination of which with any earth would convert it into a metal, and the escape of which would reduce any metal to an earth, then the transmutation of one metal into another metal would seem no more difficult than the transformation of earths into metals.

The phlogistic theory of Beccher and Stahl was considered a great advance in its day because it enabled the chemist to classify all the then known facts of chemistry. But it soon became a bar to scientific progress, and with its overthrow a new era dawned in science.

The change of a metal into another metal was not a mere theory with the alchemists, they saw repeated proofs of this transmutation. By the purifying influence of fire they made purest silver out of unquestionable lead, and the silver medals attesting this fact which Dr. Bolton lately found in Austria were the *ecce signum* of the alchemists. The Chinese still hold that lead kept in fusion for two hundred years becomes silver, and silver similarly treated changes to gold. What the alchemists required was some means to quickly transmute the whole of the lead into silver and prevent the large loss of lead when fire alone was used. The truth wrongly interpreted only led them widely astray.

The conception also of the instability of the properties of matter — that, for example, color, lustre, weight, malleability, fixedness in the fire, etc., are properties that may be imparted to a body destitute of them, irrespective of the nature of such body, just as a man may change his clothes without changing his person — was most misleading for the alchemists. "If the property is separate from the substance, like our apparel, let us clothe copper with the properties of gold and thus make it gold." The theory of the instability of matter was the quicksand that swallowed up scientific progress for the alchemists.

The indestructibility of matter, and the possibility of recovering a given substance notwithstanding all its disguises by combination with other bodies, — the persistence of matter and the immanence of its properties, — were grand discoveries in material science. They marked the transition from alchemy to chemistry. The recognition of the indestructibility of force was the second great step, the crowning discovery of modern physics. In the words of Faraday, "It is the highest law in physical science which our faculties permit us to perceive."

Shall we take a third step and proclaim the permanence of force but the destructibility of matter,— that the atom may have a life, grow old, and die, or pass back into primitive no-thing-ness, or become the ether of which we talk so much and know so little? Shall we assume that radiant force may be changed into matter and fall under the law of gravitation?

No single thought has contributed so much to give form and permanence to chemical science as the atom of Dalton. An atomic theory was indeed held by the Greeks in regard to the constitution of matter, but it related chiefly to the question of the continuity or discontinuity of matter in mass, and considered the question of the limited or unlimited divisibility of matter. But the chemical atom, with its application in explaining the law of definite and of multiple proportions by weight in chemical combinations, was the gift of the Quaker schoolmaster of Birmingham. It has furnished not merely a basis for nomenclature and notation, but has given form and substance to chemical science. Like a sentinel rock, it lifts its immovable form amid the shifting waves and tides of chemical theories. Shall the chemical atom finally be relegated to the limbo of exploded theories and creeds outgrown? The question is perhaps nearer our doors than we had suspected.

The question has been seriously raised by an eminent American chemist whether gold can be manufactured. On the affirmative side of this question he points to the fact that didymium has been split into two metals, and by recombining these two new metals the old didymium was again formed. He also points out the complex nature of yttrium as shown by Crookes by means of the spectroscope, and then proceeds to say: "These facts, and many others that could be given, make it probable that the so-called chemical elements are not really elements, but compounds, which in time we shall be able to separate into their constituents, and conversely to reproduce by combining other substances. Among the heavy elements — and hence those that would be expected to yield to the searching attacks of the chemist — is gold. It is not improbable that in time it will become possible to make gold in large quantities — an event which would throw it out of use as a standard of value, so far as it derives its own value from its rarity" (North American Review, Sept., 1890, p. 377).

At first sight this might appear to be a chemical canard, but the writer proceeds to point out the social and financial results of cheapening of gold.

The statement that didymium is a compound metal is of great interest to the chemist. But the fact that the reunion of these metals will form the old metal or alloy is not so surprising, but is what any chemist would expect. But how do such facts show the probability or even possibility of making any given metal out of heterogeneous materials? If the combination of cerium and samarium would form didymium then a plausible case would be made out. But if praseodymium and neodymium are required to make didymium, how are we nearer the manufacture of this last metal by such discovery? We must still have the two new metals to make the old metal. Suppose that gold can be split into two or ten new metals, the reunion of which will form gold, does this bring us one whit nearer the new age of gold? If it takes gold to make gold, what part or lot have baser metals in such transformations?

The trend of recent discoveries is to increase the number of simple or elementary substances. The simple nature of any substance has only been held provisionally, regarded as elementary until its compound nature is shown by exhibiting the separate elements of which it is composed. The more recondite the appliances for investigation, the more complete the differentiation of matter, the greater will be the number of elementary substances, and yet we will be as far as ever from the ability to change one metal to another.

The question of the primary and essential nature of matter belongs to metaphysics rather than physics. Yet the nature of matter as well as its properties is a vital question in chemistry. The chemist has made certain basic propositions the foundation of his science. The essential immutability of matter is a corner-stone. Weight and measure have no place in a science that deals with matter essentially variable in its nature, but it is weight and measure that have made chemistry the most exact of all natural sciences.

The idea of an original simple matter as the basis from which all things have been formed is not wholly modern. Duns Scotus advanced the idea that the basis of universal existence was a *materia primo-prima*, by the differentiation of which the individual is formed. About twenty-five years ago a modified form of this theory was brought forward by Professor Hinrichs of Iowa, who advanced his theory of "pantogen" or "urstoff" to explain the constitution of matter. There was only one simple or elementary matter, urstoff; and as all forms of matter are produced from this primary matter, he called it "pantogen," and the products formed by the reduplication of this simple matter he called "panatoms." His argument was based upon a parallelism between astronomy and chemistry: "The basis of this celestial mechanics (astronomy) is only a hypothesis, that of universal gravitation, which essentially consists in the affirmation that the heavenly bodies only differ in regard to the amount or quantity of matter. Let us have the boldness to pronounce a similar hypothesis in regard to chemical atoms. Let us suppose that the atoms of the different elements only differ in regard to quantity, that is, in regard to the number and relative position of the atoms of some one primary matter, just as the planets only differ according to the number of kilograms of ponderable matter they contain and its distribution around their axes. Since everything would be composed of this one primary matter we call it pantogen, and its atoms panatoms."

This programme of atomechanics was caustically reviewed in the *Chemical News*, December, 1867, which pointed out the fact that Professor Hinrichs, like all discoverers of his class, continually falls back on analogy. "This too free use of analogy has been the bane of science from the time of Plato, and it would appear that the race of speculators who mistake fanciful analogies for fundamental scientific laws is by no means yet extinct."

The reviewer closes by urging Professor Hinrichs, as the crowning feat of his discovery, and that which would compel the adhesion of scientific men to the new theory, "to isolate pantogen." Has the whirligig of time brought the keen editor and sharp reviewer around to face urstoff and panatoms?

How was the atom formed? Was it coeval with matter, or did matter antedate the atom? Was there *prima materia* — pantogen, protyle, urstoff — out of which the atom was formed by reduplication of urstoff upon itself? Do heredity, selection, environment, and discriminative destruction explain atomic formation, and the discrimination of atom from atom in the domain of chemistry? "A theory of evolution of this kind," says Clerk Maxwell, "cannot be applied to the case of molecules, for the individual molecules neither are born nor die; they have neither parents nor offspring; and so far from being modified by their environment, we find that two molecules of the same kind, say of hydrogen, have the same properties, though one has been compounded with carbon and buried in the earth as coal for untold ages, while the other has been occluded in the iron of a meteorite, and after unknown wanderings in the heavens has at last fallen into the hands of some terrestrial chemist."

When we attempt to apply the process of discriminative destruction the trouble increases, for "we should have to account for the disappearance of all the molecules which did not fall under one of the very limited number of kinds known to us; and to get rid of a number of indestructible bodies exceeding by far the number of the molecules of all the recognized kinds, would be one of the severest labors ever proposed to a cosmogonist." The "missing links" would form the principal chain.

But Mr. Crookes finds, by means of an interpretative illustration of the periodic law, an explanation of the formation of matter out of protyle with segregation into atoms of definite valence and proximate molecular weight.

The discovery of the periodic law of chemical elements was a long stride in scientific progress. It bids fair to be as masterful in chemistry as universal gravitation in astronomy, and a certain analogy may be traced between them. The planets have certain orbits around the sun, and velocities of revolution proportional to their mass Did position fix their mass, or mass determine their position? By the periodic law, the atom having a certain mass or weight falls into a certain position. Is the mass of an atom determined by its position, and not rather the position determined by its mass? Does the periodic law require us to consider the properties of matter as mathematical functions of numbers, and thus reproduce the Pythagorean philosophy of number and harmony, that "all things are number, and that number is the essence of everything — the elements of numbers are the elements of existence." Or have position and force acquired the properties of matter?

If there was ever a flank movement on Nature by which she has been compelled to surrender a part of her secrets it was the discovery of the spectroscope, "which enables us to peer into the very heart of nature." It is the "Open sesame" of physics and chemistry. If biology could lay its hands on a similar instrument to unlock the secrets of life, what fields of discovery would unfold before the explorer!

By means of the spectroscope we may question the very elements and submit them to cross-examination in the court of science. Surprising results have thus been reached, but the trend seems to be all in one direction, to show the complex nature of what was supposed to be simple matter, that didymium, e.g., was not a simple body, but contained at least two metals, was twin in more senses than one. It was much the same as Davy's showing that potash was not a simple body, anomalous among chemical substances, but contained a metal, and thus fell into line in chemical combinations. But does the discovery of even a nest full of metals where only yttrium was supposed to be require the assumption of meta-metals, stuff which has not yet grown to the full measure of a metal; shall we suppose that each *ultissimum elementum* has only one line in the spectrum, and that the spectroscope will yet reveal swarms of meta-metals in the chemical system, just as the telescope calls out the countless stars from the Milky Way?

On the other hand, does the splitting up of the rare metals justify the assumption that the metals most fixed in character, and which show no tendency to split into meta-metals, such as gold and platinum, are compound in constitution and may be compounded out of baser materials? Crookes's suggestion that what comes to us as copper has been shunted on to the wrong track in its passage from aboriginal elemental matter to make gold, holds out small hope to metallic transmutation.

In the use of the scientific imagination few men can compare with the editor of the *Chemical News.* Let us briefly follow Mr. Crookes in his scheme of the genesis of the elements out of ante-elemental material,— protyle, urstoff, immaterial matter, out of which matter may be formed by a process of condensation through the cooling down of the original fire-mist until it acquires elemental properties. By a process of polymerization of protyle, or reduplication of dissociated matter, with fall of temperature and acquisition of different amounts of electricity, he supposes the elements are evolved as known to us. Assuming the periodic law of Newlands and Mendeleeff, he pictures to the mind how the elements may have been formed out of matter in the ultra-gaseous condition by cooling down below the temperature of elemental dissociation, when out of the swarming myriads of ultra-elemental matter the elements may group into knots at nodal points. Around a central line, electrically, magnetically, and chemically neutral, the length of the line marking the fall of cosmic temperature, the mighty gravitative force swings like a pendulum, but with lemniscate motion through space of three dimensions, and thus the atoms are formed and the elements appear, from hydrogen to uranium. The outward swing gives the electro-positive elements; the inward swing forms the electro-negative, the degree of electrization determines the atomicity, and the position on the left or right of the neutral line determines the magnetic quality — paramagnetic or diamagnetic.

Such a scheme of the genesis of the elements fires the imagination with the loftiest conceptions, so many things fall into line and order. The very hiding place of missing elements seems to be pointed out, and newly discovered metals fall into their fore-ordained place prepared for them before the foundation of the worlds. It would seem presumptuous to question a theory so beautiful and satisfying, but its foundations are assumptions of a sweeping character. If we concede the existence of matter without the properties of matter, we have yet to learn how it can acquire the properties of matter. If we concede that it is ultra-material because of heat, how can it part with heat before it acquires radiant power, a property of matter? We might also be tempted to inquire, what has become of the heat which once held the universe in the ultra gaseous condition?

Nor is the theory of the successive formation of elementary atoms, with their progressive increase of atomic weight by reason of the fall of temperature below the point of elemental dissociation, entirely satisfactory. It is claimed that hydrogen and then lithium first appear in the elemental condensation, because with them the diminution of temperature at which elemental dissociation ceases is reached first of all, the heat being still too great for other bodies to exist even as elements. The heavy metals, such as platinum and gold, with large atomic weight, are formed later in time, because a vast reduction of cosmic heat was necessary before dissociation would cease and elemental consociation become possible. Do platinum and gold give indications of a tendency to dissociation more marked than that of lithium when questioned by heat, electricity, and chemical action, or even when cross-examined by the spectroscope? Does not gold exhibit an integrity worthy of a noble nature? Does it hold out to alchemy the most distant hint of a multiple nature by means of which she may hope to divide and conquer?

The hypothesis of the evolution of the chemical atoms by aggregation or polymerization of one matter substance challenges scientific thought. Based upon broad assumptions and sustained entirely by analogy, it will hardly disturb the relative coinage value of the metals by holding out hopes of alchemic transmutation. The advice of Mr. Crookes to treat it simply as a provisional hypothesis is conservative and wise.

NOTES AND NEWS.

TO MEET the desire for instruction in the modern branches of astronomy, which have been so wonderfully developed in the last few years, a post-graduate course in astronomy and astro-physics, open to a limited number of students, has been established at the Western University of Pennsylvania. Exceptional facilities for such a course are afforded by the library and apparatus of the Allegheny observatory. Instruction will be given by means of lectures, recitations, and examinations, and by the practical use of instruments in observation and measurement. A knowledge of mathematics equivalent to that given in the undergraduate department of the university is requisite for admission to the course, which will extend over a term of two years. Further information may be had of Dr. W. J. Holland, chancellor of the university, or of Professor J. E. Keeler, director of the Allegheny observatory.

— At Hanover, Penn., a system is used for cooling water, that is both simple and beneficial, according to a description of it in the *Railroad and Engineering Journal*. The town is described as being closely built, and without any system of drainage, so that the water in the wells is unfit to drink. Some years ago these reasons led to the introduction of a supply of very excellent water from a large spring about three miles distant. This water is brought through iron pipes, and when it reaches the consumer in summer is warm, while the water in the wells is cool. For this reason many of the inhabitants drink the well-water, and, as a consequence, typhoid-fver is a prevalent disease in that community. In order to obtain pure cool water, not impregnated with lime, some of the inhabitants of the place have adopted a plan which is so simple and gives such excellent results that it is worthy of general adoption wherever there is a water supply other than wells or springs. The plan is as follows. A cylindrical galvanized sheet-iron tank twelve inches in diameter and four or five feet long, is placed in the bottom of a well. The tank is then connected by a galvanized iron pipe with the water-supply pipes, and another pipe is carried from the tank to the surface of the ground, or to any convenient point for drawing water, and has a cock at the upper end. The tank is consequently always filled with water from the water-supply, and being in the bottom of the well, the water is cooled off and acquires the temperature of the well, so that that which is drawn from the tank is as cool as well-water, and is without any of the impurities with which the latter is contaminated. The water drawn from the tank in one of the wells in the place named had a temperature of 56° when the thermometer in the atmosphere above stood 76°. This method gives an abundant supply of cool water during the whole summer, and can be adopted in all cities, towns, or in the country. If a well is available, it can be used; if not, by simply digging a hole in the ground deep enough so as not to be affected by the surface temperature, and burying the tank, it will answer equally well. This hole might be dug in a cellar or outside the building. If the water has any impurities in suspension, such as mud, the tank should be made accessible, so that it can be cleaned separately.

— A writer in the *Illustrated American* says that in work which requires the application of great strength combined with good judgment the elephant is supreme; but as a mere puller and hauler he is not of great value. In piling logs, for example, the creature soon learns the exact manner of arranging them, and will place them upon each other with a regularity not to be excelled by a human workman. Sir Emerson Tennent, in his work on Ceylon, mentions a pair of elephants who used to raise their wood-piles to a great height by rolling the logs up an inclined plane of sloping beams. The same writer was once riding near Kandy, toward the scene of the massacre of Major Davies' party in 1803. He heard a queer sound in the jungle, like the repetition, in a hoarse and discontented tone, of the ejaculation of "Urmph, urmph!" Presently a tame elephant hove in sight, unaccompanied by any attendant. He was laboring painfully to carry a heavy beam of timber which he balanced across his tusks, but, the pathway being narrow, he had to keep his head bent in a very uncomfortable posture to permit the burden to pass endways, and the exertion and inconvenience combined led him to utter the dissatisfied noise which had frightened the horse. When the creature saw the horse and rider halt, he raised his head, reconnoitered them for a moment, and then he flung down the timber, thoroughly appreciating the situation, and pushed himself backward, among the bushwood so as to leave a passage for the horse. But as the horse did not avail itself of the path, the elephant impatiently thrust himself deeper into the jungle, repeating his cry of "Urmph!" but in a voice meant to invite and encourage. Still the horse trembled, and the rider, anxious to observe the instinct of the two intelligent creatures, forbore any interference with them. Again the elephant wedged himself farther in among the trees and waited for the horse to pass, and after the horse had done so timidly and tremblingly, the wise creature stooped, took up his heavy burden, and, balancing it on his tusks, resumed his route, hoarsely snorting his discontented grunt as before.

— Experiments in seeding with different quantities of wheat were begun on the farm belonging to the Ohio State University several years previous to the establishment of the experiment station. These enperiments have been continued on the same farm by the station, and the tenth experiment has just been harvested. In this experiment two varieties of wheat were used, Dietz and velvet chaff (Penquite's velvet). The land on which they were sown had borne nine successive crops of wheat, having been dressed three times with barnyard manure during that period. The land occupied by the velvet wheat lies upon a gravel knoll, sloping to the west, the gravel coming in some places to within two or three feet of the surface. The wheat on this knoll has for several seasons been less vigorous than in other parts of the field, and this season especially it was badly infested with the wheat midge, commonly known as the red weevil. The Dietz wheat grew upon land of a little better quality, and sloping to the east instead of the west. It was but slightly injured by insects. While the yields of the velvet are irregular, they do not favor very thin seeding. In the case of the Dietz, however, the results are decisive. Every time the seed falls below four pecks or rises above seven there is a falling off in yield. In the long run, seeding at from five to seven pecks has given a larger harvest than when less or more seed was used.

— The idea of university extension had its first expression at Oxford as far back as 1845. Since then its advance has been constant and of late years very rapid. Though Oxford was the first university to give a form to the wide-spread desire for higher education, it was almost the last to enter upon the practical details of the work. That it now has by far the larger number of extension students is due in great measure to the energy and skill of Michael E. Sadler, secretary to the Oxford Delegacy, who, in the current number of *University Extension*, discusses the future of this movement in England. Other articles show the relation of this work to the common school teacher and to American women. One of the most successful experiments of last season in extension teaching was at Providence in connection with Brown University, and is described in this August issue by Professor Appleton of that faculty. In the department of Notes is an interesting hint as to the natural connection of this movement with the Chautauquan system, so excellently developed by Bishop Vincent and his assistants.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

THE NATURAL HISTORY OF ANALOGY.[1]

By the natural history of analogy is meant the treatment according to the methods of natural science of a type of mental action interesting at once as a psychological process, and again from its practical results as a factor in the anthropological history of the race. While logically an analogy may be defined as an inference of a further degree of resemblance from a given degree of resemblance, it would be well to include in the present survey types of argument diverging somewhat from the standard. It should also be borne in mind that these reasonings may be unconsciously conducted without analysis, and yet be communicable from mind to mind, and influential in the fixation of belief and the guidance of conduct.

It will appear that the progress from the attitude of the savage to that of the civilized man with respect to the understanding of the natural and physical world, may, to a considerable extent, be regarded as a shifting of the position occupied by the argument by analogy. It would appear, too, that this form of argument, used by the scientist of to-day only with the greatest caution, is a predominant one in more primitive forms of thought. For example of such arguments we turn to three departments of mental action, closely related to one another, and each contributing to the value of the general results. We look first amongst the customs and beliefs of primitive people, then amongst the doings and sayings of children, and thirdly amongst that very extensive class of superstitions and folk-lore customs which no nation, however high or low in the scale of civilization, is without. The Zulu chewing a bit of wood to soften the heart of the man he wants to buy oxen from, the Illinois Indian stabbing the figures of those whose days they desire to shorten, the operation upon a lock of hair or the parings of the finger-nails, together with the endless forms of primitive witchcraft, rest upon the notion that one kind of connection will bring with it others. The same idea underlies the customs directing and prohibiting the use of certain food. The Malays eat tiger to acquire the cunning of that animal, the Dyaks refuse to eat deer for fear of becoming faint-hearted, and in the Mexican rite called the "eating of the god" is found an elaborated form of the same belief.

The interpretation of omens among primitive people also proceeds by analogy, the relation between omen and issue being guided by a sense of analogical fitness. To determine whether war is to be upheld or let fall, a stick is set in a bowl of rice, and if it stand the war is continued, and if it fall the war is let fall also. A somewhat less direct form of analogy appears in customs relating to images and names. The name becomes an essential part of the thing, and thus what is done to the name will affect the thing; hence the origin of the taboo, changing of the name in case of sickness, and the like. Even vaguer and more general principles of analogy may underlie important customs, such as that things go by contraries, for example, or that to produce unusual effects, drastic means and rare substances must be employed. The bizarre fancies, the grotesque performances, and the uncanny pharmacopœia of the medicine-men in part derive their character from this source. All these are but partial illustrations of the savage's fondness for the use of arguments by analogy and the naturalness with which he observes and assimilates all phenomena according to this habit.

The study of children reveals evidence of similar arguments, although the earnestness of the belief cannot be so readily tested. Moreover, we have no good collection of children's sayings and doings for such examples. In spite of this, however, their fondness for analogical arguments may be regarded as an additional point of resemblance connecting the infancy of the individual with that of the race.

The superstitions current among us — survivals from a culture which they are of to a culture which they are in — abound in instances of analogy, simple and complex. Especially fertile fields for such instances are the beliefs concerning dream-interpretation, those underlying the practices of folk-medicine, those connected with names and numbers, and, in more systematized form, the doctrine of sympathy, and signatures of astrology and kindred sciences. The modern cheap dreambook is full of quaint arguments by analogy. Whan it tells us that to dream of gloom means imprisonment, that the pine-apple in dreams is the omen of crosses and troubles, that to dream "of being mounted on stilts denotes that you are puffed up with vain pride," to dream of onions indicates the betrayal of secrets, to dream "of a dairy showeth the dreamer to be of a milksop nature," and that a zebra indicates a checkered life, — we see what various and peculiar results may be reached by such logic. The many customs and superstitions connected with such numbers as three, seven, and thirteen need but be referred to to show how thoroughly this variety of thought-habits is permeated with the argument by analogy.

The remedies of folk-medicine easily reveal the analogies through which they originated. The connection of toads with warts is due to nothing more than the warty appearance of the toad's skin; the snail is used for ear-ache because of the many snail-like passages in the ear, red things are used for fevers, yellow things for liver complaints, and many of the peculiar and disgusting remedies of our forefathers clearly imply that out-of-the-way substances must have special efficacy.

[1] Abstract of an address before the Section of Anthropology of the American Association for the Advancement of Science, at Washington, D.C., Aug. 19–25, 1891, by Joseph Jastrow, vice-president of the section.

The doctrine of signatures depends on the notion that the appearance of plants signify their use. The eye-bright, on account of the eye-like spot in its corolla, is used for eyes; the granulated roots of the saxifrage indicate its use for calculous complaints; the human shape of the roots of ginseng give it special efficacy; and the walnut, the parts of which so closely resemble the skull and brain, is marked out for the mental diseases. The doctrine of sympathies has appeared under various forms, and has quite an important history. The common phrase, "Take a hair of the dog that bit you," is a survival of this system, and shows that the logic underlying it is nothing more than that two phenomena once connected, either by coincidence or as cause and effect, will continue to maintain this connection. Paracelsus describes a peculiarly composed weapon-salve which was to be applied to the weapon that caused the wound and thus heal the wound. Sir Kenelm Digby's practices involve the same notion. He procured a handkerchief or other personal belonging of the patient, and when this was dipped in water, the fever abated, and the like. The sympathetic alphabet was another form of this doctrine. Two friends each cut a piece of skin and grafted it on the skin of the other; on this was tattooed an alphabet, and communication was established by the belief that pricking a letter on the skin of the one friend would cause a pain in the corresponding place of the other. Even in the present century two Frenchmen announced the discovery of a species of snails which, however widely separated, would go through the same movements, so that if the one is guided over an alphabet the other will rest upon the same letters.

The most systematic of all these pseudo-sciences is astrology, the analogies underlying which being of all grades of remoteness. The system of correspondences which it proposed gave unusual opportunity for flights of imagination, and no analogy, however far-fetched, was too slight for the foundation of some doctrine. The accident by which the planets were given the names of deities was sufficient to connect the characters of those deities with the lives of persons at whose births these planets presented especial relations. Similarly the fact that constellations were named by fancied resemblances to certain animals was sufficient to connect one's career with the qualities of that animal; thus a child born under the sign of a lion would be courageous, but one born under the crab would not go forward in life.

Amongst the various generalizations upon which these considerations have bearing, attention will be called to the following. The history of the argument by analogy adds another link to the chain of evidence by which the development of the individual is connected with that of the race. We trace similar appearances amongst savages, amongst children, and still more strikingly in those surviving forms of superstition and pseudo-scientific systems which we are warranted in regarding as reversions to more primitive types of thought. Again, the principle that what was once the serious business of adults serves in more advanced stages of culture for the play of children or the amusement of leisure hours, finds illustration here. Just as the drum, once the terrifying instrument of the warrior, or the rattle, once the potent implement of the medicine-man, has become the toy of children, or as the bow and arrow are maintained for sport only, so the outgrown forms of thought, the analogies, that were serious to our ancestors, now find application in riddles and puns. When we ask, "Why is this one object like another?" we are asking for just such out-of-the-way resemblances as have been noted above. And, finally, in a variety of ways, the consideration of the argument by analogy adds to our appreciation of the unfoldment of mental powers, of the slow and painful steps by which the tenets of modern science have been gained, of the necessity for continued striving in this direction, as well as of the underlying unity of movement and design by which these phenomena acquire their deeper and more human interest.

THE ETHER.[1]

IT was with some fear and trembling that I selected as the subject of a brief address a subject of such vast dimensions, and the feeling increased as it became more and more evident how difficult it is to give clear expression to ideas that are very far from clear.

In former days many reasons were given showing the necessity for the existence of an ether which do not seem conclusive now. We can scarcely appreciate the bearing of an argument to the effect that there must be an ether or nature would be disgusted with the major portion of space. We should begin at once to wonder what there could have been in the experience or training of any person that could lead him to such a conclusion. We do not see the need of an ether to hold up the stars and planets and prevent them from falling to the ground. We do not try to explain by similar means how the planets are kept in motion.

We do, however, have other needs for ether, which seem important and pressing; still we cannot help wondering occasionally, with Theophrastus Such, what kind of hornpipe we are dancing now. How will our ideas commend themselves to those who follow?

For many years it was taught that the luminiferous ether was an incompressible jelly-like mass, and that light is an elastic pulsation in this medium. The elastic theory, however, was burdened with serious difficulty. No phenomena corresponding to a vibration normal to the wave front could be found, but mathematical analysis showed that such waves should in general exist in an elastic medium. Green saw that this wave would produce no optical phenomena if the velocity were either zero or infinite, and concluded that it could not be zero in a stable medium. Those who followed him in time also accepted his conclusion that the ether was incompressible, and that the compression-rarefaction wave must travel with an infinite speed. So the matter stood until 1865, when Maxwell proposed an electro-magnetic theory of light. According to this theory of light no compression-rarefaction wave should exist, and light was conceived to consist of local electrical displacement in a plane at right-angles to the line of propagation.

The rival theory met with great favor. It gradually became clear that Maxwell's theory of light was attended with less difficulty than the elastic theory. Twenty-three years later, Sir William Thomson brings a powerful reinforcement to the elastic theory which changes the whole aspect of the case. He simply suggests that the compression-rarefaction wave could properly and logically be gotten rid of in the elastic theory by making its velocity zero, instead of infinite, as Green had done half a century before. What Thomson did was to examine anew the ground upon which Green had concluded that a zero velocity for the compression wave involved an unstable state of the medium, and it was found that such a conclusion did not follow.

[1] Abstract of an address before the Section of Physics of the American Association for the Advancement of Science, at Washington, D.C., Aug. 19–25, 1891, by Francis E. Nipher, vice-president of the section.

And it is worthy of remark, as a matter of congratulation, showing how far scientific men have emerged from the intellectual pugilism of the last century, that this audacious departure was met with pleased surprise, instead of angry polemics against a new heresy.

The modern theory of the ether took its origin with the undulatory theory of light. It had for a tangible basis the observed fact that light requires time for transmission. Whether measured over long distances through interplanetary spaces, or through short distances on the surface of the earth, the time required for transmission is proportionate to the distance. It was to such facts that men finally came to look for a justification of the assumption of an all-pervading medium. The modern theories of the nature of the ether are based wholly on the results which must be produced by this invisible machinery, instead of upon an assumed dictum that Nature abhors a vacuum. Perhaps no teaching of science is now more firmly established than the doctrine of the existence of an ether, and that it is capable of transmitting energy by virtue of peculiarities which must be as definite as those which characterize a train of cog-wheels.

But when one comes to assemble all of the results which remain to be accounted for and explained, it becomes exceedingly difficult to construct a mental image, in three-dimensional space, of the machinery capable of producing them all.

Green's idea of the ether makes it an incompressible, frictionless, structureless jelly, sometimes called a "solid," which opens out and allows the particles of ordinary matter to sweep through without appreciable resistance. Thomas Young likened the operation to the sweeping of the wind through the leaves and branches of a forest. Certain well-known electrical experiments of Faraday and Cavendish seem to require the assumption that electricity is, or is some function of, an incompressible medium. On the other hand, the slowing up of light in space occupied by matter indicates that the ether within must be either more dense (as Fresnel believed) or less elastic than that existing in free space. It is certainly very difficult to understand what there can be in the molecules of matter which can increase the density of an incompressible medium, as the experiments of Fresnel seemed to require; nor is it as yet easy on any hypothesis to account for those condensed films of bound ether which are carried along with the particles of moving matter. They seem to be differentiated with equal sharpness from the free ether which sweeps through matter, and from the spinning aggregation of ether vortices which Thomson assumes may perhaps make up the molecule or the atom. Certainly it would seem that a vortex ring in a medium so devoid of friction that these vortices are permanent, could hardly drag along with it portions of the surrounding medium, from which the analysis of Helmholtz shows it must be wholly and forever differentiated. And the matter is not simplified by the beautiful experiment of Michelson and Morley. It appears that the frictionless ether adheres in a layer around the earth as a whole, or at least that it was entangled in and carried along with the matter composing the building in which their experiments were made.

If, however, one forms a Torricellian vacuum in a barometer tube of either transparent or opaque material, it is easily and completely shown, by an inclination of the tube, that the ether flows freely through matter. Whether the ether be incompressible or highly compressible, it seems to be as impossible to compress it in a chamber surrounded by matter as it would be to compress water or air in a fisher's net. The fact that a rotational phenomenon, such as must exist in the field of a steel magnet, is maintained indefinitely without the expenditure of energy, must certainly justify the assumption that the ether is frictionless, that the ether-vortex atom is a possibility.

The effects which seem to be nearest to a mechanical explanation are those which result in heat or light and electrical and magnetic induction. It is possible to construct machinery which will represent the conditions for propagation of a magnetic induction in a plane radial to a conducting wire. A train of cog-wheels separated by elastic idle-wheels which articulate with them, or a series of smooth rimmed fly wheels connected by elastic bands, will do the work. It becomes more difficult when we spread this paraphernalia into three-dimensional space.

No one, of course, thinks of the geared ether models of Maxwell and Fitzgerald as anything more than an aid to a conception of the nature of the action to be explained. When we come down to the working drawings we find great room for conjecture, and some demand for invention. Do the particular cog-wheels which slip on each other without friction at the surface and within the body of a perfect conductor ever get outside of the body into free space where they must gear rigidly with each other? If so, why do they behave so differently in the two places? What happens to this gearing when masses of matter which it permeates are set into rotation? Is there any difference between the earth's magnetism and the motion of masses of ether at the earth's surface? It is exceedingly difficult to understand how a frictionless medium in which a magnetic spin is permanent, can offer resistance to shear, unless the rigidity involved is due to motion.

Another function which the ether should perform is the transmission of gravitation. The theory which has attracted most attention, the only one suggested which has been seriously considered, is the one first announced by La Sage of Geneva, and elaborated by Preston and others. It seems to require that the ether shall partake of the nature of the gas, the mean free path being of interplanetary dimensions.

Such a medium it is not difficult to admit as a possibility. The theory accounts for the gravitation of bodies towards each other as due to the difference in the bombardment of bodies on the exposed and sheltered sides. Each body shields the other, so that gravitating bodies are pushed together. It is, however, necessary that the particles at the centre of the earth shall have the same resultant differential pressure directly exerted upon them, causing them to gravitate towards the sun, as if the surrounding mass of the earth were removed. It is, in fact, necessary to assume that nearly all the ether particles which plunge into the earth's figure pass straight through the earth without encounter with matter.

It is, however, of some interest to know quantitatively about what velocities must be involved in such an impact theory of gravitation. DeVolson Wood has made a computation of the density of an elastic medium capable of transmitting a pulsation with the velocity of light, and of transmitting from the sun to the earth 2.8 calories per minute per square centimetre of surface. While it seems to me that some fault may be found with his analysis, still the results reached by him seem to be of the proper order of magnitude.

The density of the ether turns out to be about $\frac{2.6}{1024}$ pounds per cubic foot, so that a mass equal in volume to that of the earth would contain about a pound and seven-tenths. This value for density lies well within the limits which Sir William Thomson assigned to the same quantity.

Suppose a stream of ether of such material should sweep radially sunward, its particles colliding in unelastic impact with the earth, what velocity must be given to this current in order that the earth might be kept in its present orbit? The velocity turns out to be eight millions of times the velocity of light. The mass of ether colliding per second would be 14,000 tons, which is equal to the mass of a sphere of water having a radius of about fifty feet.

But in LeSage's hypothesis the ether particles do not move in parallel stream-lines. They plunge into the earth on all sides, the sheltering effect of each gravitating body upon the other being the cause of gravitation. But this sheltering effect is very small, by reason of the open structure that matter must be assumed to have in order that the interior particles of large masses may be accessible to direct impact. It follows that the percentage of particles really effective in producing gravitation must be very small; likewise that the individual particle velocities must enormously exceed the velocity computed for a stream of ether sweeping radially sunward and capable of holding the earth in its orbit.

It is unphilosophical to condemn the theory of LeSage because it requires us to deal with such immense velocities. Any theory of gravitation must involve something unusual, and it was pointed out by Laplace that the velocity of gravitation must enormously exceed that of light. But there are other difficulties.

The rebound of the particles must be a perfectly elastic collision; otherwise the bombarded body will rise in temperature. By reason of the open structure assumed and necessary, in order that the effective surface may be proportional to mass, the exterior figure is of no importance. For simplicity of conception, if we assume a solitary sphere in space, it will be symmetrically beaten from all sides. The particles which pass straight through, without deflection or elastic rebound, will be symmetrical all around, as will likewise the few which suffer reflection. A second body now appearing in its field will shield the first by deflecting particles which would otherwise strike it, but will reflect to the body an equal number which would otherwise not strike it, the latter group having the same average momentum as the former.

Sir William Thomson has suggested that the difficulty may be avoided by assuming that the collision is not a perfectly elastic one, and that the rise in temperature may be prevented by rotation of the colliding particles. This might be true of the ether particles, but there is the best of reason for believing that there is no molecular rotation in solid bodies.

It seems probable, therefore, that a rebound sufficiently unelastic to account for gravitation must result in a rise of temperature, which can scarcely be admitted. The theory has, however, been defended with great skill by Preston, who has attempted to show that such a medium may even produce the transverse vibrations of light. The objection that gravitation must travel at enormously greater speed than light he tries to meet by the hypothesis that the gaseous ether may have two groups of particles, one much larger than the other. The properties of the luminiferous ether have, however, been so well worked out in the last four or five years, that it seems hardly probable that the gaseous ether can be admitted as the medium which transmits light. Whether gravitation can or cannot be explained in some such way as LeSage suggested, it seems worthy of question whether the gravitation medium can be ether which transmits radiant energy with a velocity of 300,000,000 of metres per second. Sir William Thomson's last word on the elastic solid theory of ether, according to which the compression wave is impossible by reason of a property which is imparted to the medium, seems to cut off the last hope that the elastic solid luminiferous ether can be concerned in gravitation. The electric theory of light does not require Sir William Thomson's limitation to be put upon the medium. According to this theory the medium may be incompressible, and there is strong reason to believe that it is practically so. As Willard Gibbs has pointed out, the two theories seem to be practically on the same footing, if the third wave is given an infinite velocity in the electric theory, and zero velocity in the elastic solid theory.

There are other points concerning the action of matter upon the ether which are perhaps in a fair way to receive a clearer solution. The observed fact that light travels in water with a speed of about three-fourths of what it has in air, apparently means that the transmitting medium is either more dense or less rigid in water than in air. Fresnel's hypothesis is that its rigidity is the same in the two media. His formula, as developed by Eisenlohr, for the relative motion of ether and matter which it permeates, when the matter is set into motion, assumes, clearly and baldly, that the ether is more dense inside of matter than in free space. The amount of ether occupying a volume of one cubic centimetre will condense to nine-sixteenths of a centimetre on passing into water. It is compressed until its density is nearly double. To be more accurate, its density increases by seven-ninths of itself upon passing into water. Of course this is to be regarded as a mathematical fiction serving to bridge over a gap in our knowledge of the physics of the ether. Certainly a medium behaving in this manner would not be considered to be a shining success as an incompressible medium. Fresnel's conclusion rests mainly on an experiment first made by him and repeated with great success in an improved form by Michelson and Morley. This experiment was to determine the effect of moving water upon the velocity of light transmitted along its stream-lines. The result reached was that the resultant velocity of light is its velocity in the quiescent liquid plus or minus seven-sixteenths of the velocity of the moving liquid.

The velocity of the water current was varied between 8.72 metres and 5.67 metres per second, in Michelson and Morley's experiment. A series was made with an intermediate velocity of 7.65 metres per second. The weights of the three determinations are quite different, and it appears to be still an open question whether the result obtained is independent of the velocity of the water. In Eisenlohr's analysis he assumes a prism of matter moving bodily through a mass of quiescent ether. In Michelson and Morley's experiment the water was fed from an upper to a lower tank, passing on its way through the experimental tubes. The conditions of the two experiments do not seem to be necessarily the same. The bounding surface between air and water is moving with a very small velocity in the apparatus of Michelson and Morley, and the observations are made through a fixed region of space. It is not clear that this difference is of importance, but it seems possible that it may be, in determining the effects for different velocities.

The close agreement between the observed value of the velocity coefficient for the moving ether and the value computed on the assumption of an actual condensation of the ether, is, of course, a very worthy consideration. Still it seems very improbable that such a condensation can really take place. The ether may lag behind the moving water without any condensation, and the other phenomenon requiring a greater density in matter than exists in free space, may, perhaps, receive other explanations that do less violence to our ideas. Ether, in which the complex molecules of matter are entangled, certainly might act as if it were more dense without really being so.

What the experiment of Michelson and Morley seems to show is that the ether is swept along by the water, but lags behind. The question of density appears to me still to be an open one. Maxwell's experiment with a prism which was, as was then supposed, moving through ether at a speed of 18.6 miles per second, seems to have a very different relation to Fresnel's theory if the ether at the earth's surface is moving with it.

It does not seem hopeless to repeat the experiment of Michelson and Morley on a railway coach, with water or carbon bisulphide at rest in the tube, if the road-bed and the car selected are of the best construction, and the apparatus is elastically supported.

It would be necessary, probably, to rigidly connect the observer's seat and the water tube, and to support them, with the observer, by helical steel springs surrounded by rubber tubes filled with glycerine to dampen the vibrations.

A speed of forty miles per hour will more than compensate for the suppression of one water column, which will be replaced by air. This is precisely the form of experiment upon which Eisenlohr's analysis is based. In this form the conditions of the experiment are capable of great variation. The car becomes really the moving body, and the transparent region within through which the light passes, may be shielded by any kind of opaque matter. Whatever the results may be, they can hardly fail to add greatly to our knowledge of the effect of moving masses upon the luminiferous ether.

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.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Jugglery.

IN *Science* for Aug. 14 there was an inquiry, quoted from *Illustrated News of the World*, as to the source of a certain statement regarding the apparently marvellous feats of Indian jugglers. In this statement it had been suggested that the spectators had been hypnotized by the performer, and hence imagined they saw something which the "snap-shot" of a kodak proved did not exist at all. I remember reading this very circumstantial account in an evening paper, and cut it out to send to India. After some search I have found the original reference. The story, as a quotation from the Chicago *Tribune*, was published in the *Evening Star* of Washington, D.C., on Aug. 30, 1890. Its author, Frederick S. Ellmore, purported to be a graduate of Yale College, and to have travelled extensively in India with an artist friend, a Mr. Lessing. It has since transpired that no person by this name is a graduate of Yale.

To my mind the story shows a good many signs of being on the Mulhatton style, and could easily have been written by some one who had never been in India. It is very plain that no juggler could by any possibility hypnotize a mixed audience all the time changing. Those who have seen the original growth of the mango-tree under the manipulations of the performer, who was stark naked except for a *lungooti* (breech cloth), will be inclined to smile at Hermann's explanation given in *Science*. My father has spent twenty years in India, and has seen this performance repeatedly. He has noted one singular coincidence, in that the tree is never made to grow except in the season when the leaves and fruit of the mango-tree are in proper order for the exhibition.

H. A. HAZEN.

Washington, D.C., Aug. 18.

The Rain-Makers.

EVERY reader of *Science* has seen the recent telegram from Midland, Texas, Aug. 11, "Preliminary explosions made yesterday; raining to-day." It may be well, with the apparent brilliant success of this remarkable undertaking before us, to examine this question at length.

Ever since the time of Plutarch the idea has been prevalent that great battles are invariably followed by rain. In the earliest times, before the introduction of gunpowder, it was thought that exhalations from the dead bodies might assist in precipitating the moisture, but in more recent times there has been a well-nigh universal belief among soldiers that heavy cannonading or firing will produce rainfall. Whence comes this common thought were there not a fact to originate and back it up? We may as well ask, whence comes the well-nigh universal belief that the moon has a marked influence upon the weather? Now it is well known that in the latter case, most careful researches extending over a century have shown either no effect at all, or one that was either contradictory in different periods, or almost inappreciable.

Now since the moon's influence must be almost infinitesimal, as every one can readily see, it would be difficult, perhaps, to determine its exact relation to weather changes which are so complex, but it would seem far otherwise as to the determination of the exact effect of explosions upon the atmosphere. A careful study of this question has been made by Mr. Edward Powers, who has found that 158 of the smaller and larger battles of the Rebellion were followed by rain, usually twenty-four hours afterward. It might be asked, is it possible that this list comprises all the cases? While some of the battles may have been omitted, yet it seems highly probable that a diligent search must have revealed most if not all there were. It is a most remarkable fact that no mention whatever is made of the battles that were not followed by rain, and yet in an inquiry of this kind it is very essential to examine both sides of the question. During the war of the Rebellion there were over 2,200 battles, on an average probably as severe as the average of the 158 above mentioned; that is to say, about seven per cent of the battles were followed by rain. Is it at all incredible that seven per cent of these battles were followed by natural rain? In the case of the battle of Bull Run, which Mr. Powers especially picks out as a bright and shining example of his theory that explosions produce rain, it has been ascertained that there was a heavy rain in South Carolina on the first day of the battle. This rain had been previously noted farther south, and this was the rain felt at Bull Run. It would be very interesting to look up the question of how many of these 158 apparent successes were due to natural causes, but unquestionably almost all, if not all, may be ascribed to that cause. It is interesting to note that it is thought this influence may extend twenty-four hours after the explosions cease. This inference, however, is hardly tenable, for the reason that the current in which these explosions take place is borne along at the rate of 20, and, in higher strata, at 30, 40, 50, and more, miles per hour, so that the specific influence from them will be carried at least 500 miles away in twenty-four hours. If we wished to determine the effect, we would need to go to that distance from the spot where the explosions were made, and the rain that came in twenty-four hours at that spot could not by any possibility be due to the explosions.

There is only one other point to be noted here. It has been stated that while the Central Pacific Railroad was being built across the Sierra Nevada Mountains, it was necessary to explode hundreds of kegs of gunpowder every day, and this tremendous fusillade was accompanied by torrents of rain, which had never been noted before in that region, and have not been noted since. If this is a fact, it was a most remarkable phenomenon, and it would seem as though it might be established by indubitable evidence. It is a little singular that no dates or definite statements which could be verified have been given. Present rainfall reports show an abundance of rain except in two or three of the hottest months, and it seems entirely probable that persons who had been accustomed to the remarkable and long continued dryness of the plains were struck by what appeared like most abundant moisture in the mountains just at a time when there was none on the plain.

We are now prepared to investigate the value of the telegraphed result from Texas. Any one who will examine the weather maps, now sown broadcast over almost the whole country, will find that on the 11th instant there was a natural rain which extended over the whole of Texas and adjacent regions. One thing seems very evident, that absolutely no rain can be obtained out of a dry atmosphere. If the explosions can produce rain in limited quantities, yet their influence must always be exceedingly slight, and the expense of the explosions must always be all out of proportion to the amount of good done. Professor Harrington has well said that these experiments begin at the wrong end. The time may be ripe for experimenting in the atmosphere upon the cause of rain, about which we now know practically nothing. It must be conceded that until we do first experiment upon the cause of rain, all time and money used in making gross explosions will be wasted.

H. A. HAZEN.

Washington, D.C., Aug. 17.

P. S. — Since writing the above, a telegram from Midland, dated Aug. 19, states that several more preliminary explosions were made on Aug. 18, and that immediately thereafter rain began falling and continued over four hours. An examination of the weather maps for Aug. 18 has shown that the rain began, to the north of Texas, at least eleven hours before the explosions, and covered an area of over 800,000 square miles. The final tests were to be made on the 20th. H. A. H.

Experiments on Snake Locomotion.

IT is a well-known fact that a snake moves along over the ground by means of adjustable plates or scutes situated on the ventral surface of the body. How the movements of these scutes succeed each other, and what relations the different convolutions of the body bear to one another, are not so satisfactorily known. Whoever has examined the mechanism of the scutes will, I think, come to the conclusion that they must be moved by the costal muscles, and that this movement must consist in a posterior depression by which the scute offers an opposing surface to the ground. In all probability this depression is both downward and backward, thus imparting a slight forward impulse to the body. If this view of the case is correct, we would naturally expect that the act of locomotion would consist in some sort of fusion or succession of these minute individual impulses. Owing to the rapidity with which these movements are normally executed it is impossible to analyze or define their exact nature, and accordingly experiment seems to offer the only trustworthy guide to a solution of the problem. In experimenting, however, we are encountered with great difficulties at the very outset.

If we could succeed in recording the movements of an animal by means of apparatus, the construction of which was ever so delicate, can we rely on this record as a faithful expression of the natural and unimpeded movements of the animal? We can hardly feel at liberty to do so. There are at least two causes which may vitiate the results: (1) the animal is excited and annoyed by the experiments and does not act naturally; (2) the apparatus used in the experiment may directly impede the organs in the discharge of their normal functions. But while these difficulties render it impossible to obtain a record which is trustworthy in all respects, yet approximate results may be obtained which will lead up to a correct solution in the end.

In considering the locomotion of the snake, it may be well first to state what we know and what we do not know. We know that the snake generally moves on a horizontal or inclined plane, rarely elevating any part of the body to a very considerable distance above that plane. It sometimes moves with its body straightened and in a straight line, but far more frequently the body is placed so as to resemble a sinusoid, and its movements have a lateral and a direct component. The larger convolutions of the body occur in those portions which have the greatest mean diameter. The convolutions do not form simultaneously, but each travels the whole length of the body, like a wave of water, being at no two consecutive moments composed of the same parts. These waves succeed each other on opposite sides of the body, thus producing a reciprocal curve. Each wave travels from the head towards the tail, and drives its predecessor of opposite phase before it until it disappears at the tail. At times the curves do not shift to alternate sides of the body, but successive curves are formed on the same side. This motion, be it observed, is totally distinct from the reciprocal curvings described above. So much for what can be directly observed. But we cannot tell by direct observation the curves which different parts of the body would describe were they to mark the surfaces over which they move. Nor can we observe the movements of the scutes, or their correlations with the movements of the body as a whole. If we are to understand these activities, we must do so by experiment.

The following was the method of experiment employed. Short pieces of thread were run through bits of sponge saturated with ink, and these were tied around the body of the snake so that the sponges would come on the ventral surface. When these were securely tied the animal was placed on a strip of coarse paper and allowed to move. So long as the sponges were properly supplied with ink every movement made by the parts of the body thus provided was marked on the paper. Now if the different sponges were soaked with ink of different color, the simultaneous movements of different parts would be recorded, and, theoretically, with a sufficient number of sponges placed at proper intervals we would secure a complete record of all the bodily movements during a sustained period of locomotion. Such a record, however, it is impossible to obtain, for reasons which need not be mentioned.

The curves obtained by this method were by no means uniform, but varied both with the direction and velocity of the movements, and apparently with the caprice of the animal. The separate curves described by different parts of the body cannot be said to be characterized by any marked idiosyncracies. On the contrary, they appear to vary at random, now being marked by acute angles followed by beautifully rounded sinuosities, which in turn may be succeeded by protracted and irregular curves or at times figure-of-eight tracings. There is this distinction, however, between the curves described by the middle of the body and those of the distal parts. They have not so great an amplitude and are less variable. Contrary to what we would naturally expect, the synchronous curves described by different parts of the body have no discoverable agreement either in phase or in form.

From this description it might be inferred that very little of value could be derived from a study of such curves. But further study shows this inference to be ill-sustained. In interpreting the curves it is well to remember that they do not represent perfectly normal movements, because the scutes over which the sponges were tied were impeded in their action, and because rough paper is even smoother than the average ground over which the snake moves. Owing to this last circumstance the scutes would slip, and the curves would thus be shorter.

After making due allowance for the conditions which embarrass the experiments, we may perhaps still speak with some degree of confidence as to the general results, and possibly discover the existence of some fundamental laws. Perhaps the most striking fact about all the curves is, that, with very rare exceptions, they are described on opposite sides of an ideal line which may be called the axis of motion. While they demonstrate that the snake's body is capable of an almost infinite variety of movements, yet lateral movements generally prevail. There is also a tendency to consecutive repetitions, sinuosities following sinuosities, and angularities following angularities. The most irregular curves are described when the animal executes slow and hesitating movements. In this case the curves may be extended on both sides of the axis of motion, or confined to one side, when the curve is a tolerably regular succession of semicircles whose adjacent arcs form cusps. During rapid motion the sinusoid is by far the most common curve described. In fact, it may be regarded as the typical curve described by the snake's body.

It is instructive to note that when the curve assumed by the body is a sinusoid, then the curves described by different points of the body are sinusoids. The relation becomes intelligible when we reflect that the curves of the body partake of a wave-like motion, each particle vibrating, as it were, from the crest of one convolution across the axis of motion to the crest of a succeeding convolution of opposite phase, and all the while progressing in a general direction parallel to the axis of motion. At this point it may be asked, what advantage is secured by this curvilinear motion? The chief advantage seems to be that those portions of the body placed transversely to the axis of motion furnish better fulcra from which the anterior parts of the body may be projected forward. If this is the correct explanation, then, during the forward movement of that part of the body anterior to the transverse flexure, the scutes are for the most part passive, and the anterior parts are projected by the median muscles. This seems to be a good reason for believing that the scutes do not act in continuous succession from before backwards, but intermittently and perhaps to some extent simultaneously, being interrupted by shoves and pulls which annul and complicate their action. The problem of their motion, however, is a difficult one, and more experimentation is needed before the laws of their action can be confidently and fully formulated. J. LAWTON WILLIAMS.

Hornellsville, N.Y., Aug. 18.

Black and Bright Bulb Thermometers in Vacuo.

IN reply to an inquiry in this journal for Aug. 7, I would say that the formulæ for these radiation thermometers will be found in the "Annual Report of the Chief Signal Officer for 1885," pp. 131–134. Professor Ferrel has also made an exhaustive study of a special investigation of a large number of these thermometers, which will be found in "Professional Papers, Signal Service," XIII., pp. 34–50.

Several notices have appeared in *Nature* from time to time. It would seem that serious discrepancies have been found in these instruments, and it is still a mooted question as to their source. Professor Ferrel found, as was to be expected, that the ventilation of the bulbs was a most important factor. H. A. HAZEN.

Washington, D.C., Aug. 18.

AMONG THE PUBLISHERS.

THE most timely feature of the September number of the *New England Magazine* is an article on the late "Edward Burgess and His Boats." The writer is A. G. McVey, the yachting editor of the Boston *Herald*.

—D. C. Heath & Co., Boston, will issue, about the first of September, "Andersen's Marchen," selected, arranged, and edited, with notes and vocabulary, by Professor O. B. Super of Dickinson College, Pa.

—In the *Atlantic Monthly* for September John Fiske has a paper on "Europe and Cathay," which discusses the reasons why early Norse discoverers of America were not its real discoverers. In the same number is a description of the Japanese Feast of Lanterns and the Market of the Dead, by Lafcadio Hearn.

—"Practical Work in Organic Chemistry," by Frederick William Streatfeild, just published by Spon, is one of the Finsbury Technical Manuals. The Finsbury Technical College gives instruction in both day and evening classes to those who wish to qualify themselves for filling positions requiring technical skill. The author, who is the demonstrator of chemistry at Finsbury, after describing the operations in organic chemistry, such as purification, crystallization, determination of melting point, and the mode of analysis, devotes most of his space to oxalic acid, alcohol, the fats and oils, and the coal-tar products.

—Everyone interested in the betterment of public roads and highways should read the article, in the September *Lippincott's Magazine*, by John Gilmer Speed on "Country Roads and Highways." That we have very bad roads in this country is an accepted fact, but few realize how very bad they are in comparison with those of many foreign countries. Besides calling attention to the wretched condition of our roads, and telling what has been done in different States for their betterment, Mr. Speed offers some valuable suggestions.

—The Academy of Music in this city will open its coming season on Thursday, Sept. 3, with a romantic spectacular play called "The Soudan." This drama was produced, and ran for two seasons, at the Drury Lane Theatre, London, under the title of "Human Nature." The story, which is a strong one, deals with events which occurred during the campaign for the relief of Gen. Gordon and other Europeans, who were held prisoners at Khartoum by the Arabs, during the war in the Soudan. The scenes, which are laid in England and Egypt, afford an excellent opportunity for a display of grandeur such as few other attractions of the kind can boast of. The Arab city, attacked and carried by English soldiers, or the surging crowd at Trafalgar Square, London, cheering and shouting words of welcome to the victorious Guards, makes a never-to-be-forgotten stage-picture.

SCIENCE

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SCIENCE

NEW YORK, SEPTEMBER 4, 1891.

THE FUTURE OF SYSTEMATIC BOTANY.[1]

THE address of Vice-President Coulter was a departure from the custom of presenting either an interesting bit of research or a summarized view of information concerning some subject. The speaker invited the attention of the section to an ancient department of work. The ancient history of systematic botany is too well known, he said, to need even brief repetition, but the one desire which runs with increasing force through it all is to reach eventually a natural system of classification. At first, from necessity, plants were simply systematically pigeon-holed for future reference, and those who could thus dispose of plants were known as "systematic botanists," an appellation proper enough, but one unfortunately not having sufficiently outgrown its original application. The unfortunate result of this early necessity of so rigidly systematizing facts and thus rendering them accessible was to make the pigeon-holes as permanent as the facts they were intended temporarily to contain.

As soon as knowledge justified the attempt, "natural systems" of classification began to be proposed; and one natural arrangement has succeeded another, from that day to this, until in those of to-day we have presented simply what the earliest contained, viz., the expression of man's knowledge of affinity, the difference being a slowly diminishing amount of artificial padding.

Systematic botany, as formerly understood, has probably done all that it could, unaided, in the natural arrangement of plants. It could indefinitely juggle with sequences and nomenclature, but this is of secondary importance when the real purpose of systematic botany is considered. But it was not left without aid, and a group of new departments was made possible by the microscope and the unexampled progress of powers and manipulation. The study of the cell and of nascent and mature organs, and the recognition of plants as living things that are the resultant of the interplay of internal and external forces, have revivified the ancient mummy called botany, and have made it a living thing, capable of endless development.

Some one has said that "the highest reach of the human mind is a natural system of classification." This simply means that when the results of all departments of botanical work are well in hand, then the systematists will be in a position to put on a sure foundation the structure they have always been planning. The real systematic botany, therefore, is to sum up and utilize the results of all other departments, and its work is well-nigh all in the future. It is bound to be the last expression of a human thought with reference to plant life, just as it was the first. The systematic botany which deals with genetic characters and recognizes the fact that every plant is a living thing, with a history and all degrees of consanguinity, and that the final form of every natural classification must be to approximate to the order of descent, is in its early infancy.

[1] Abstract of an address before the Section of Biology of the American Association for the Advancement of Science, at Washington, D.C., Aug. 19-25, 1891, by John M. Coulter, vice-president of the section.

The position then taken by the speaker was that for the systematists of to day and of the future there must be three distinct lines of work, related to each other in natural sequence in the order presented, and each turning over its completed product to the next.

The preliminary phase of systematic botany, the collection and description of plants, is that which most frequently stands for the whole in the popular mind. The speaker explained the disrepute into which it seems to have fallen in certain scientific quarters by the fact that this popular impression was resented. He spoke of the inspiring nature of the pursuit after new species, and said that it sometimes became almost a mania, or too attractive to the incompetent. But even this ancient kind of work sadly needs improvement. Many things besides the mere sporadic collection and recording of species should be included as legitimately belonging to this line of research. A plant is too often a text without any context, and is thus robbed of much of its significance. Nothing seems more unsystematic than field-work in systematic botany. All information that can be obtained in the field concerning species is the province of the collector to procure and of the taxonomist to record. The speaker protested against the search for species as for diamonds, as things solely valuable in themselves apart from their surroundings, and he urged the conversion of collecting trips into biological surveys. He expressed great gratitude to the noble army of self-denying pioneer collectors, but claimed that the time had now come when the same amount of labor could be expended to better advantage, and that a race of field-workers must be trained who shall follow their profession as distinctly and scientifically as the race of topographers. "In this centre of public scientific work in which we have met, devoted to obtaining the largest amount of information in regard to our material possessions, and with means commensurate with the largest plans, it seems an appropriate thing to urge a thoroughly equipped system of biological surveys. This subject is not a new one here, and steps have already been taken to organize some work of this kind, but I desire to voice the sentiment of this section in commending all that has been done in this direction, and in urging that the organization be made more general and extensive."

In reference to the work of description, the speaker read an unpublished note of Professor Asa Gray, in which that distinguished botanist lamented the work of those who were incompetent. The speaker also expressed the opinion that the exclusive use of gross organs in the description of higher plants would be given up, and that the more stable, minute characters would prove valuable aids in studying diagnosis. A danger in the use of these minute characters was pointed out, viz., the tendency to use a single set of minute characters too far, and to make the fabric of a whole group conform to it. The character of a species is an extremely composite affair, and it must stand or fall by the sum total of its peculiarities and not by a single one. There is nothing that involves a broader grasp of facts — the use of an inspiration rather than a rule — than the proper discrimination of species.

"I have dwelt thus upon the work of collection and description both to magnify it and to indicate that its proper position is that of a preliminary phase in the study of systematic botany."

The work of searching for the affinities of great groups is the crying need of systematic botany to-day. The speaker called attention to the danger of magnifying the importance of certain periods or organs in indicating affinities, and summed up what was said under this head as follows: "I have thus spoken of the study of life-histories to indicate that its chief function lies in the field of systematic botany; to suggest that it take into account development at every period and of every organ, and so obtain a mass of cumulative evidence for safe generalization, and to urge upon those not thoroughly equipped great caution in publication."

The speaker spoke of the necessity of constructing a natural system with easy advance in the knowledge of affinities, as a convenient summary of information, a sort of mile-post, to tell of progress and to direct future effort. The concluding summary was as follows: "The points presented in this consideration of the third phase of systematic botany are that the last and highest expression of systematic work is the construction of a natural system, based upon the accumulations of those who collect and describe, and those who study life histories; that this work involves the completest command of literature and the highest powers of generalization; that it is essential to progress for a natural system to be attempted with every advance in knowledge, and that all the known facts of affinity, thus brought within reach, should be expressed in all systematic literature. In conclusion, I have but to say that I have attempted to indicate the true relation which exists among the different phases of systematic botany; to point out an affinity which there is danger of ignoring, and to maintain that all these departments of work, looking to the same end, are equally important, equally honorable."

THE FARMER AND TAXATION.[1]

QUESTIONS of taxation have played a prominent part in the polity of English-speaking communities for many centuries, and they have not been without importance in the history of other civilized countries as well. A history of English taxation would be in no small part a history of the English people itself.

It was a quarrel about taxation between the nobles and King John which led to the granting of the Great Charter, and thus planted the seeds of modern constitutional government. English liberty indeed has been developed chiefly in connection with disputes about taxation. Charles I. owed the loss of his throne and of his head largely to his determination to levy such taxes as he pleased without consulting the great men of his realm. English obstinacy in regard to the principle of taxing the colonies led to the American Revolution and the disruption of the British Empire. It was at bottom a question of taxation which led to the French Revolution, and the turning and overturning of Europe which has hardly ceased even now. And the history of this century on the continent shows how fundamental tax questions are to the welfare and prosperity of modern nations.

Of late the question has become of even more importance, and has acquired a very different aspect from that of former centuries. The disputes about taxation were, down to a recent date, largely of a political nature. They turned, not so much on the amount of the tax or the manner in which it should be levied, as upon the point who should say whether it should be levied at all or not. The rulers or ruling classes tried to keep the whole question within their own control, and those who were opposed to this were trying to get the right to vote or refuse taxes. Now every civilized country in western Europe and America vests the right to say what taxes should be levied, and how they shall be levied, in the people or their representatives. It is accepted as a definite principle that the people are the sole source of the authority to determine what taxes should be levied.

We have indeed always had that principle accepted in this country, to a greater or less extent, and in all its fulness, ever since the Revolution. People thought formerly that as soon as that principle was accepted tax problems would be solved. But it did not take long to find out how great an error this notion was. Hardly had the principle been accepted as a part of the fundamental law of the country when the representatives of the people found out that they were only at the verge, so to speak, of the question. The political side of the problem had been settled to a certain extent, but that only left room for the economic aspect to appear in sight, with a vast array of the most difficult questions. It soon became evident that under the systems of taxation in existence some people paid more than they ought to, and some paid less. Some classes were taxed but lightly or not at all and others very heavily. Then began the fight between the classes, between those exempted by law and those subjected by law to taxation. This conflict was slowly fought through, and now in nearly all civilized countries there are few classes exempted by law from taxation. But it was soon found that it was not necessary to exempt by law in order to take advantage of circumstances in such a way as to materially lighten one's burdens. Then began another struggle between the various classes as to which could shift the burden of taxation more completely, under the forms of law, to the shoulders of the other. The town was arrayed against the country, the producer against the consumer, the rich against the poor, the laborer against the capitalist, etc. We are still in the thick of this fight, and there is no sign of an end to it. It is raging in all countries alike. Our tax problems are not very different in some of their most important features from the tax problems of England, France, and Germany, and each of these countries can learn something from the experience, the successes and failures, of the others.

The problem is all the more difficult because, even if all parties were willing to do exactly the fair thing, we should still find it difficult to determine exactly what the fair thing is. Where you cannot obtain common consent as to what is fair and proper, we need not expect that private individuals will relax their efforts to get exemptions, and make laws under which they can escape what others may consider their fair share of taxation.

The matter is destined to become more rather than less important, and that from several reasons. In the first place the amount of money to be raised by taxation is destined to increase pretty steadily, if not very rapidly. This fact, of course, makes a bad system of taxation become worse with every increase of the amount. If, for example, we had in this country to raise only a small sum for public purposes, say ten million dollars in all, for federal, state, and local governments, it would not matter much how we raised it. We might have an income tax on all incomes over ten thousand dollars a year, or on all incomes of less than that, or a uniform tax on lands irrespective of their value, or even on polls; and while it might be very unequal, yet the whole

[1] Address before the Section of Economic Science and Statistics of the American Association for the Advancement of Science, at Washington, D.C., Aug. 19–25, 1891, by Edmund J. James, vice-president of the section.

amount would be so slight that it would not be worth while complaining about it. Even such a sum as a hundred million a year could be raised very easily by almost any system of taxation. But when you want to raise seven hundred millions it is a very different matter. A system of taxation which would yield a small sum becomes absolutely insupportable when you attempt to raise a large sum by it.

There are some theorists, it is true, who maintain that all the revenues necessary for public purposes could be raised easily by a land tax, or by an income tax, or by an excise tax. Such people have given little study to the organic nature of the State. In determining how much of a burden an organic body can bear, you must consider not only the weight itself but also its distribution. Take a soldier, for example. Would you measure the burden which he could carry in the field by the amount he could drag in the shape of an iron ball attached to one of his feet, or the amount he could carry in one hand, or suspended from one finger? Of course not. Every one recognizes that a load which would tire a man out completely in a few hours if placed on one part of the body can be carried for an indefinite period if only it be properly distributed. So with taxation. Any single tax presses down and destroys or tends to destroy some one part of the economic body. Increase it and you not only destroy that part but, by sympathy, the whole body economic. Given a system of taxation then, which will yield a certain revenue easily without injuring any part of the body economic, if you double the amount to be raised, you will in all probability make the system absolutely insupportable.

Now this is exactly what we have done in this country. We have in essence the same system of taxation which was in vogue a hundred years ago. Indeed we may say that in all its most important features it is the same as was adopted in England in the time of Queen Elizabeth, for our ancestors brought it with them and adopted it almost without change when they settled the country. In the mean time our industry has changed, our agriculture has changed, we have changed our style of dress. We wear different hats, a better boot and shoe; we drive a better horse, milk a better cow, fatten a better hog, have invented a new plough, invented and utilized the railroad, steamboat, mowing-machine, reaper, self-binder, etc., but we stick to an antiquated system of taxation which was not very good at the time it was adopted and has become worse ever since. If we were willing to abolish the public school system entirely, give up trying to improve the roads, starve the inmates of our jails and alms-houses, tie up our insane to a post until they die of starvation and neglect, go back to the fourteenth century system of sanitation, abolish universal suffrage, and set up a class of nobles and kings to rule over us, perhaps we could get money enough out of the community to serve such public purposes as would then be necessary by the system of taxation which we now have. I take it, however, that we are not going to do any of these things. On the contrary, we propose to have better schools, better roads, take better care of our poor, be more reasonable in our treatment of the insane and criminal classes, establish better conditions of public health, do more to develop our industries,— in a word, we propose to advance and not decline in civilization. All this will require more money than we have now, and a system of public revenue must be established which will not only enable us to raise the sums at present demanded but very much larger sums, and at a less cost of effort.

Think for a moment how enormously the expenditure for public purposes has increased of late years in all civilized countries. The ordinary expenditures of the Federal Government for the decade 1791–1800 were about four millions of dollars. For the decade 1870–1879 it was more than forty times as much, while the population was only about twelve times as great. In the State of New York the amount raised by taxation rose from twenty millions in 1861 to fifty millions in 1870; in Massachusetts, from eight to twenty-two millions in the same period approximately; and in Ohio, from eleven to twenty-two. In the fifteen years from 1860 to 1875 the total amount raised by taxation rose in Baltimore by 110 per cent; in Boston, 241; Brooklyn, 313; Chicago, 1445; Cincinnati, 377; Detroit, 384; Louisville, 318; Milwaukee, 326; Newark, 558; New York, 430; Philadelphia, 317, etc. For fourteen large cities the amount of increase was 363 per cent, while the population increased only seventy per cent. Now it is plain that a tax system which might have been at least bearable in 1860 was in all probability out of all reason in 1875, when nearly four times the revenue had to be raised by it.

Taking all the cities in Massachusetts, they paid six dollars per head in taxes in 1861 and over seventeen dollars in 1875. The city debts had increased from less than eight dollars per head to over fifty-four per head. Even if we take the period after the war, from 1866 to 1876, and take the average of 130 cities in the United States, including therefore the smaller ones also, it will be seen that the taxes rose from sixty-four to one hundred and thirteen million dollars. They have not declined since, but have all risen at least as rapidly as the population.

This phenomenon is not by any means confined to our own country but is quite as noticeable abroad. The expenses of Vienna rose from thirty-seven to sixty-seven million francs in the years from 1865 to 1874, Breslau from four to eight, Florence from nine to twenty-four, Berlin from eighteen to forty-six. Paris rose from eighty-three to one hundred and ninety-six million francs in ten years. Thirty-two cities of Prussia increased their taxes eighty-three per cent in seven years.

A moment's reflection will convince any of you of the enormous increase in this burden, even if you did not have these figures.

You all know that the expense for schools has become enormously greater than formerly. Every country district must now have its school taught from five to six months in the year by a teacher who gets on the average nearly twice as much as two generations ago. Every little village must have its system of graded schools, and if it gets a trifle larger, must have its high school. We are now calling for manual training in the schools, and we are no longer satisfied with the horrible accommodations for teacher and pupils which used to satisfy our fathers. Our poor-houses must be at least half-way decent places, our jails are vastly improved, etc. In a word, our expenditures are vastly greater, and consequently the sum of money to be raised by taxation. As a result the revenue system has broken down, and there are loud calls for a better one.

Now in deciding upon a system of public revenue, two things are to be kept in view. We must first of all find out where the wealth is that we wish to reach, and second, we must then adopt the best system we can devise to find and tax that wealth. There is no use of adopting specific taxes unless there is something to be taxed.

Now here is just the difficulty in our present condition. Our tax system does not correspond to our industrial conditions. It was devised in all its essential features over three centuries ago, and has undergone little change. If we except the indirect taxes like customs duties, our present system is based on the idea that the chief wealth of the country is in its agricultural districts, in its farms, and consequently it is adapted to reach the main elements in such a condition of society. But nothing could be further from the truth. It was so a century ago, but has long ceased to be so.

In 1790 there was no railroad in the country, scarcely any banks, few trades, little manufacturing, scarce a dozen corporations in the whole country, no very large cities, and ninety-seven per cent of the people lived in the country. What wealth there was was in the country — in the farms and lands and farm products. A system of taxation based on this fact worked fairly well.

How is it now? Where is the bulk of the wealth of this great country of ours? It is no longer in the country: it is in the cities, in and around which nearly half the population is aggregated. It is no longer in agriculture; it is in railroads; it is in gas companies, in street-car lines, in merchandizing and trading, — everywhere but in farming. The earnings of the railroads of the country during the year 1888 were over one thousand millions of dollars. We have no reports as yet on the earnings of gas companies, electric-light companies, telephone companies, street-car lines, telegraph companies, express companies, sleeping-car companies, manufacturing corporations, standard oil monopoly, cotton-seed oil trust. They mount up into the hundreds of millions every year. The profit of trade in the agricultural products of the country alone amount to more than the total value of those products only a few decades back. In a word, the wealth has been steadily flowing away from the farms and into other forms.

This has come about in two ways: first, by the natural increase of manufacturing industry and of commerce in an age of steam and electricity, which would show relative increase of capital invested in those branches; and second, by the actual fall of late years in all farm values in the old and settled communities incident to the opening up of new fields, which are enabled to compete in the world's market by the cheapening of transportation in railway and steamship service. Not only Dakota and Montana compete in London with the Pennsylvania wheat, but also India, Russia, and even Africa. There has been a great fall of late in the value of farm staples in the world's market, which has depressed the value of farms in all the settled countries, — in England, France, and Germany, as well as in our Eastern States. There are no signs that those prices will go up again, at least in your day and mine.

Africa, South America, India, Russia, and Australia will be opened up faster than the demand for bread-stuffs will increase, and you may be sure that Europe will not pay as high prices for our surplus wheat and corn when it can get cheaper supplies elsewhere. We need expect then no recovery in farm values so far as these depend on the price of staple commodities.

In examining this question of taxation, then, let us impress upon our minds several points: first, that we cannot hope to get money where it is not, no matter how good our system may be; second, that the wealth of the country is no longer in its farms; third, that the present revenue system is based on that supposition, and that consequently our whole revenue system must be radically changed to bring it into harmony with our modern industrial conditions.

No mere tinkering or pottering around with existing taxes is going to help. We must make up our minds to go to the root of the matter at once; recognize that if we wish revenue we must reach the place where it is, and not try to get it from where it is not.

Before proposing our remedy it is desirable to glance at our present system and its effect. We have already seen that it is inadequate to meet the demands we are making and shall make upon it. It is simply impossible to get adequate revenue from it.

There is, however, another reason why our present revenue system is unsatisfactory besides the mere reason that it can not meet the heavier demands upon it, i.e., than its insufficiency to get the necessary revenue, and that is, that, owing to the great changes in our industry, it has become grossly unjust.

We may characterize the system as a whole as the general-property tax system, i.e., the effort is made to ascertain the valuation of the entire property belonging to every taxable, and then to collect a certain per cent of that valuation for the use of the public. Even if it were possible to ascertain such value, and collect the tax levied upon it, the system would be a grossly unequal one, and undesirable from many points of view. It would tax, for example, the thrifty farmer who had accumulated from his savings a sum sufficient to purchase a small farm in proportion to his thrift and savings; while it would let the extravagant lawyer or physician who makes thousands of dollars every year and lives it all up, go scot-free of all taxation. All those classes who use up their income as they go along would escape taxation, while those who save and invest it in some form of property would have to bear all the burden of taxation. It would, in a word, discourage savings and encourage waste. Such a tax makes no distinction between the people of small property and those of large means.

The true principle of taxation is not every one in proportion to his property, but every one in proportion to his ability; and ability is not measured by possession of property alone, since a man of large means may better afford to give a larger sum than a person of small means a small sum. A general-property tax, moreover, takes no account of whether the property is available for purposes of income or not. A person is taxed upon what he has, irrespective of the fact whether he can get anything out of it or not. And so I might go on and show how unequal and wasteful such a tax is, even if it could be fully assessed and collected; but the fundamental objection to it is that it can never be assessed and collected. To make it even approximately complete you must rely on the declaration of the taxable that he has given a full and true list of his property. A portion of this property can, of course, be seen, such as houses and lands and furniture, implements and tools, pictures, books, pianos, etc. But another class cannot be seen; such are stocks and bonds, notes, mortgages where owned outside of the community, etc., and all other forms of immaterial rights. It is impossible to assess these things except upon the personal declaration of the owner. Now everybody who has looked into the matter at all agrees, I believe, that this cannot be relied upon at all.

All tax commissions which have reported upon this point say that existing laws do not secure such a return. Taxables commit perjury by wholesale in such matters, and think nothing of it. How much of this sort of property escapes taxation can be seen from examining the tax books and reports of any of our leading American cities. We have, of course, no adequate statistics of the relative value of personalty and real estate for any country or part of a country. No one, however, estimates the value of the personal property held by the inhabitants of a great city at anything less than the total value of the real estate, and it is my opinion that it is much more. According to the report of the tax commission of the State of New York in 1871, the real estate assessed in that State for the years 1869-70 was more than three and one-half times as valuable as all the personal property owned by citizens of that State. In the city of Brooklyn the valuation of real estate was over ten times as much as that of personal property, Rochester over six times, Buffalo and Albany over four times as much, In the city of New York it was nearly two and one-half times as much. One county in New York reports real estate worth seventy times as much as all the personal property owned by its citizens. Massachusetts, which has perhaps the best enforced law of this kind, does not reach over two-thirds of the personal property in the opinion of its tax collectors. Connecticut misses forty per cent. One may almost say that in the large cities much the larger half of the personal property escapes taxation altogether. That means, of course, that the other forms of property are disproportionately burdened. The total personal property of the entire State of New York was returned in 1870 at $434,000,000. Why, there were at that time in the city of New York alone twenty-five individuals who together probably possessed that sum. The value of the steam railroads in that State in that year was $300,000,000. In a debate in the constitutional convention of 1867, Mr. Pierrepont of New York said that he could name thirty individuals in New York City whose combined personal property exceeded the whole assessment of the State for that year by a very large sum. The whole personal property assessment of the city of Brooklyn against private individuals for the year 1867 was less than ten million dollars. Possibly it had a single citizen who was worth that amount.

But why multiply examples. They are like sands of the sea for multitude. Now, under any such a system as this, those classes who have, comparatively speaking, little personal property are the ones who must bear the burden of taxation. Who are they? Speaking generally, the farmer in the country and the small man in the city; the laborer who has saved up money to buy him a little house, and whose whole property is, therefore, open to the assessor; the farmer who has put all his money into his farm. Who profits by it? The man of means who invests his money in railroads, bank stock, gas companies, etc.

The objection which I have been urging against the general-property tax which forms the backbone of our system would apply more or less to the system at all times; but it is becoming more and more potent as time goes on, owing to the fact above mentioned that the proportion of wealth in an immaterial form, such as stocks and bonds, is steadily increasing. I hardly need to dwell upon this point. You all know how enormously the value of railroads in this country is increasing. Nearly all of it consists of immaterial or personal property; or where it consists of real estate, the value of such real estate cannot be measured by the ordinary standards, but it possesses a value growing out of the peculiar business of the railroad which is rarely reflected as it should be in the tax books. The railroad is the most striking example, but not even is it so important as the aggregate of similar undertakings in other lines of business. Consider for a moment the stock of express companies, telegraph companies, telephone companies, gas companies, electric lighting companies, joint stock banks, manufacturing companies, etc. Indeed, the marked tendency of capital to-day is to assume the corporate form, owing, among other things, to the ease with which it escapes taxation. This is a phenomenon of comparatively recent date. The corporation first became a prominent feature of our industrial life, as of that of other countries, since 1850. There were, of course, many corporations before that date, and one or two flush periods when nearly everybody took a hand in them, but they were confined to few departments of industry. After 1850 they grew rapidly. In Germany, for example, only 54 are known to have been founded before 1850, while 1,150 have been formed since that time. In Austria there were in 1857 only 58 in all, but they had risen to 731 by 1873. England and America are, however, the classic lands for the development of corporations. In 1844 there were 119 in England, but they had increased to 2,549 in 1862, and by 1886 over 25,000 had taken out charters, though many of them had wound up their affairs, so that only 11,000 were in operation in that year, with a paid up capital of over three thousand millions of dollars.

In this country we have accurate statistics only for a few of the States, and then only in regard to certain formal facts. In Massachusetts, from 1852 to 1863, anywhere from ten to fifty companies were formed each year. The next three years averaged three times as many; then came a long period up to 1880 in which about seventy-five to one hundred were established each year, and since 1880 an enormous number have been formed, rising to 233 in 1889. The total capital of these companies aggregated upwards of $300,000,000. In the State of Ohio in 1889 over three hundred corporations for manufacturing purposes were organized, and the average for the last ten years has been over two hundred. Now all these things mean, of course, that property of the community is all the while taking on more and more the personal property form, is leaving the country for the city, and that any general-property tax system is becoming more and more unequal owing to impossibility of keeping track of it. With every passing year, then, our present system is becoming more and more untenable, and yet we are not ready to break with it.

There is still another circumstance which should be considered in this connection before leaving it, as having a special relation to the farming classes, and that is the rapidly changing proportion between town and country population. It is easier to avoid personal property taxation in the city than in the country. And thus from this reason also the burden of taxation becomes more unequal. In 1790 only three per cent of the population of the United States lived in cities of 8,000 and upwards In 1800 (using round numbers), four per cent, in 1810 five per cent, 1830 seven, 1840 nine per cent, 1850 thirteen, 1860 sixteen, 1870 twenty-one, and in 1880 twenty-three. It is not yet known exactly what the new census will show in this respect, as the population of all cities above eight thousand has not been given. But some figures have been given to show that this tendency has steadily increased. In 1880 there were twenty-four cities in the United States with 75,000 inhabitants and over, while in 1890 this number had increased to thirty-four, i.e., while ten years ago about thirteen per cent of the people of the country were living in cities of 75,000 and over, to-day over sixteen per cent are to be found in such cities. The increase of these thirty-four cities, without counting New York, has been almost forty-five per cent, while the general increase in the country as a whole has not exceeded twenty-five per cent. Reports have been also published of forty-two other cities having a population of 20,000 or over. The increase in the seventy-six cities over the population of the same cities in

1880 was about forty-eight per cent. The census may be faulty, but I take it that we shall have to admit that growth of the cities has been much more rapid than that of the country. This being so, it still further tends to increase the burdens of those classes who can least easily conceal their property under a general-property tax system, viz., the farmers.

The rapid growth of the cities, in many cases at the expense of the country, tends, moreover, to leave a continually increasing burden of expense upon the shoulders of the rural districts, which tends to overburden the latter still more.

Under our system of taxation, then, the farmer, using that term for the country districts in general, is at a disadvantage in several respects. In the first place, as we have seen, our method of obtaining public revenue by taxation touches chiefly that form of property which is visible and can not escape the eye of the tax assesssor or tax collector; while that which can be hidden, or known only by a general system of registry, such as mortgages, bonds, stocks, etc., practically escapes taxation altogether. Now the farmer has a larger proportion of his property in this form than any other class. If he is thrifty he can buy more land, put up a better class of buildings, get a better breed of stock, use better machinery, etc. Every improvement in his condition, in a word, reflects itself in something visible about the farm, and thus subjects him to heavier taxation. It is very different with the inhabitants of the cities. A wealthy man, of course, occupies as a rule a better house in a dearer neighborhood than a poor man, and to that extent pays more taxes; but as his wealth increases, his house does not necessarily grow better. His scale of living may not increase proportionately. A millionaire is quite as likely to live on as great a scale as one who has ten times the property. As a result, the visible forms of wealth do not increase as rapidly in the case of the wealthy city man as in the case of the country farmer. More and more of the property takes the form of mortgages, bank, railroad, and manufacturing stock, and bonds. All these things escape the eye of the tax assessor, and to that extent relatively lighten the burden of the wealthier classes.

(To be continued.)

NOTES AND NEWS.

THE bacillus of tuberculosis, says *Nature*, is often to be found in places lived in by consumptives. Herr Prausnitz has lately collected the dust in various compartments of trains which often convey patients from Berlin to Meran, and inoculated a number of guinea-pigs with it. Two out of five compartments so examined were found to contain the bacillus; the dust of one rendered three out of four guinea-pigs tuberculous, that of the other, two. The animals were killed after ten to twelve weeks, but in no case was the disease very advanced; the author supposes the number of bacilli to have been but small. The facts, however, seem to point to the necessity of disinfection of such railway carriages, especially the carpets or mats.

— Under the will of Dr. Fothergill (1821), funds were bequeathed to the Society of Arts, London, for the offer of medals for subjects, in the first instance, relating to the prevention of fire. The society now offers a gold medal or £20 for the best invention having for its object the prevention or extinction of fires in theatres or other places of public amusement. In cases where the invention is in actual use, reference should be made to places where it could be inspected. A full description of the invention, accompanied by such drawings or models as are necessary for its elucidation, must be sent in on or before the 31st of December, 1891, to the secretary of the Society of Arts, John Street, Adelphi, London. The council reserve the right of withholding the prize, in case there is nothing, in their opinion, deserving the award, or sufficiently complying with the conditions sent in for competition.

— To the usual well-known ways of stimulating muscles to contraction, viz., electrical, thermal, mechanical, and chemical, M. D'Arsonval has recently added that by means of light (*Nature*, Aug. 20). He could not, indeed, get any contraction in a fresh frog-muscle, when he suddenly threw bright light on it in a dark chamber; but having first in darkness stimulated a muscle with induction currents too weak to give a visible effect, and then suddenly illuminated the muscle with an arc light, the muscle showed slight tremulation. Not thinking this conclusive, however, M. D'Arsonval attached a muscle to the middle of a piece of skin stretched on a funnel, and connected the tube of the funnel, by means of a piece of india-rubber tube, with the ear. The muscle being now subjected to intense intermittent light, he heard a tone corresponding to the period of illumination, and this ceased when the muscle was killed with heat. Arc light was used, which was concentrated by a lens and passed through an alum-solution to stop the heat rays.

— From a recent issue of *Nature* we learn that M. Raspail has lately called attention in the Zoölogical Society of France to the serious diminution of birds in that country through destruction of their nests. Some insectivorous species are becoming very rare, while the ravages of parasites on useful plants are extending. Boys, of course, do a great deal of the mischief; and of the various animals which attack nests (the squirrel, the hedgehog, the dormouse, the magpie, etc.), M. Raspail regards the cat as the worst offender. On a recently wooded property of about seven acres he observed last year as follows: Out of thirty-seven nests, carefully watched, only eight succeeded; twenty-nine were destroyed, fourteen of these by the cat, though effort had been made to ward off this insatiable marauder. On a large property in the centre of a village the owner had about eighty cats annually caught in traps. The place having lately changed hands, the gardeners estimate that more than one hundred nests were destroyed last year, three-fourths of these by cats. M. Raspail advocates a rigorous application of the law for protection of insectivorous species, the disqualification of the cat as a domestic animal, and the giving of prizes to foresters and others for destruction of all animals which prey on eggs and young in the nest.

— Tobacco fermentation, a very essential process, is brought about by firmly packing ripe tobacco in large quantities. *Nature* states that it had been generally supposed that the fermentation is of purely chemical nature, but Herr Suchsland, of the German Botanical Society, finds that a fungus is concerned in it. In all the tobaccos he examined, he found large quantities of fungi, though of only two or three species. Bacteriaceæ were predominant, but Coccaceæ also occurred. When they were taken and increased by pure cultivation, and added to other kinds of tobacco, they produced changes of taste and smell which recalled those of their original nutritive base. In cultivation of tobacco in Germany it has been sought to get a good quality, chiefly by ground cultivation and introduction of the best kinds of tobacco. But it is pointed out that failure of the best success may be due to the fact that the more active fermenting fungi of the original country are not brought with the seeds, and the ferments here cannot give such good results. Experiments made with a view to improvement on the lines suggested have apparently proved successful.

— Experiments in various methods of seeding wheat have been conducted for a series of years at the Ohio Experiment Station, with the following results: In the average of four years' experiments, wheat covered one inch or less has produced at the rate of thirty-four bushels per acre, that covered two inches has produced thirty-five bushels, and that covered three inches thirty-four bushels. Judging from a smaller number of experiments it does not seem advisable to sow deeper than three inches. In the average of six years, wheat sown with the roller-press drill has yielded about eight per cent more than that sown with the ordinary drill. More or less increase has followed the roller-press in almost every season, but a single trial has given results unfavorable to the use of the common roller after seeding. Broadcast wheat has this year yielded about the same as that drilled; but in the average of five years the produce from broadcast seed is considerably smaller than from the same quantity of seed drilled. The results of seven years' experiments point clearly to the latter part of September or first of October as the most favorable season for sowing wheat on this farm. A single experiment, made this year, fails to show any advantage in favor of cross drilling over sowing the same quantity of seed in the ordinary manner. No larger crop has been produced this year from mixed seed of two varieties than from pure seed of the same varieties sown separately. The land upon which these experiments were made lies in the valley of the Olentangy, one of the largest branches of the Scioto. The soil is a yellow loam, part first and part second bottom. It is either naturally underdrained with gravel or artificially drained with tiles, and its average yield of wheat for thirteen years has been over twenty-six bushels per acre, on an annual acreage of about thirty acres.

— The laughing plant is the name of a plant growing in Arabia, and, according to the *Medical Times*, is so called by reason of the effect produced upon those who eat its seeds The plant is of moderate size, with bright yellow flowers, and soft, velvety seed-pods, each of which contains two or three seeds resembling black beans. The natives of the district where the plant grows dry these seeds and reduce them to powder. A dose of this powder has similar effects to those arising from the inhalation of laughing-gas. It causes the most sober person to dance, shout, and laugh with the boisterous excitement of a madman, and to rush about cutting the most ridiculous capers for about an hour. At the expiration of this time exhaustion sets in, and the excited person falls asleep, to awake after several hours with no recollection of his antics.

— The following persons will be the officers of the American Association for the Advancement of Science for the ensuing year: President, Professor Joseph Le Conte of the University of California; vice-presidents, Section A, Professor J. H. Eastman, Naval Observatory, Washington; B, Professor B. F. Thomas, State University, Columbus, O.; C, Dr. Alfred Springer, Cincinnati; D, Professor John D. Johnson, Washington University, St. Louis; E, Professor H. S. Williams of Cornell; F, Professor S. P. Gage of Cornell; H, W. H. Holmes of Washington; I, S. Dana Horton, Pomeroy, Ohio; permanent secretary, F. W. Putnam of Harvard University; general secretary, Amos W. Butler, Brookville, Ind.; secretary of the councils, Professor T. H. Norton, Cincinnati; secretaries of sections: A, Professor W. Upton of Brown University; B, Professor Brown Ayers, Tulane University, New Orleans; C, Professor J. L. Howe, Polytechnic Institute, Louisville; D, Professor H. Landuth of Vanderbilt University, Tenn.; E, Professor R. D. Salisbury, State University, Madison, Wis.; F, Professor L. B. D. Halstead, Rutgers College; H, Mr. Colin of Philadelphia; I, Professor Lester Ward of the Geological Survey, Washington; treasurer, William Lilly, Mauch Chunk, Penn.; auditors, Dr. H. Wheatland, Salem, Mass , and Professor Mehan, Germantown, Penn. The next meeting of the association will be held in August, 1892, at Rochester, N.Y.

— A meeting was held in Washington, on Aug. 28, at the Columbian University, which promises to result in the formation of one of the most valuable organizations in the country for the advancement of geological work, and especially of official geological work. This is an official organization of the directors of the state and national geological surveys. There were present at the meeting Maj. J. W. Powell, director of the United States geological survey; Professor James Hall, State geologist of New York; Professor J. M. Safford, State geologist of Tennessee; Professor J. W. Spencer, State geologist of Georgia; Professor E. A. Smith, State geologist of Alabama; Professor J. A. Holmes, State geologist of North Carolina; Mr. Arthur Winslow, State geologist of Missouri; Mr. E. T. Dumble, State geologist of Texas; and Professor J. Lindahl, State geologist of Illinois. Maj. Powell was elected chairman of the meeting and Mr. Winslow was elected secretary. After a few preliminary remarks in explanation of the reasons for calling the meeting, Mr. Winslow read a paper suggesting a plan of organization and explaining the objects of and the results to be derived from such an official association. As prominent among the important objects of the associatton the following may be cited: (1) the determination of the proper objects of public geological work; (2) the improvement of methods; (3) the unification of methods; (4) the establishment of the proper relative spheres and functions of national and state surveys; (5) co-operation in works of common interest, and the prevention of duplication of work; (6) The elevation of the standard of public geologic work, and the sustenance of an appreciation of its value; (7) the inauguration of surveys by States not having such at present, to co-operate with the other State surveys and with the national survey. As an immediate result of this meeting a committee of six was elected to consider the matter of organization, with the power to frame a constitution and by-laws, to be reported to the association at a time and place to be selected by the committee. This committee consists of Maj. J. W. Powell, chairman; Professor E. A. Smith, Professor J. A. Homes, Dr. J. C. Branner, Mr. Arthur Winslow, and Professor W. H. Winchell. It is a matter of sincere congratulation that the association, whose organization has been an oft-mooted question, is now in a fair condition to become an established fact. That it will serve as an invaluable agent in securing harmony and efficiency in the important public work will be readily appreciated.

— Snow-drifts are found a serious disturbance of the Russian railway system. With a view to forecasting such occurrences, according to *Nature*, M. Sresnewskij has lately collected information about snow-drifts on the Russian lines during 1879–89 (*Rep. für Met.*). The drifts occur in the northern and eastern governments, chiefly with south-west wind, but in southern Russia with north east. In the north greater gradiants are required than in the south. The maximum of the drifting is in mid-winter, but there is more in the second half of winter than in the first, that having more snow. In the course of winter the snow grows in thickness, so that in March there is more to drift than in December. The marked diminution of drifting in February is due to the less wind in that month (a fact not yet explained, as the number of cyclones shows no decrease). Two kinds of drifting are distinguished; it may be only or chiefly snow lying on the ground that is whirled and carried along, or the wind may drive falling snow. There are most drifts in the months that have least snowfall and the smallest number of days of snow. The snow-drifts in South Russia with north-east wind are chiefly connected with anticyclones in the central region, or cyclones on the southern border; those in the east and north with cyclones in European Russia. In central Russia they occur with cyclonic winds of various direction, seldom with anticyclones.

— An investigation (more comprehensive than the previous ones by Forel, Fritz, and others) of the variations of Alpine glaciers has been recently made by Herr Richter of the German and Austrian Alpine Club. To six advances of glaciers, previously known, he adds three, and his account of the six differs somewhat from previous ones. The dates of commencement of the nine advances are 1592, 1630, 1675, 1712, 1735, 1767, 1814, 1835, 1875 (?). The following are some of Richter's conclusions, as given in *Nature* of Aug. 20: Glacier advances recur in periods varying between twenty and forty-five years; on the average of three centuries, thirty-five years. The advances are not all of equal intensity, nor alike in their progress. Nor is the intensity in a given advance-period the same in all glaciers. In the case of some glaciers, a period is occasionally skipped, the advance or retirement being very weak, so that the thirty-five years period gives place to one of seventy years. The glacier variations correspond, in general, with Brückner's climate variations. The glacier advance generally begins a few years after the moist and cool period has set in. There is no good reason to suppose that, in historic time, before the sixteenth century, the Alpine glaciers were smaller than now, or that variations occurred of a different order and period from those of the last three hundred years. About 1880 the earth was passing through a moist and cold period, which should have resulted in a general advance; but the advance has been but slight hitherto, and, in the eastern Alps, mostly absent. The cause of this is not at present clear, but the mild nature of this last cold period may have something to do with it.

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and one hundred copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

THE SELF-PURIFICATION OF RIVERS.[1]

WE have evidently placed too much confidence in the innate power of rivers to throw off the evil effects of pollution by sewage, which power we now see is largely imaginary. On the other hand, we find, if we may believe the authorities, some comfort in the fact that the bogy of the present day, the microbe, has not that miraculous vitality which popular belief has attributed to it, and is even to be disposed of by so commonplace a matter as sedimentation. Dr. Frankland in the course of his paper refers more than once to the remarkable powers of self-purification of the Thames. That our metropolitan river must practise this virtue to a prominent degree is manifest from the cruel ill-usage to which we subject it; but we gather that the author referred chiefly to the up-country reaches. Below bridge, especially in the neighborhood of Barking and Erith reaches, no self-purification could compensate for the filthy flood that is daily discharged at Crossness. There have been reports of various highly paid experts from time to time, the reading of which would lead one to suppose that there was nothing, or little, to be desired in regard to the state of the water in this region. But those who live near the banks, or whose duty takes them down the river, know how misleading these reports are. At low water especially, the banks are formed by reeking flats of sewage deposit, and when a steamer passes along and churns up the filthy sediment the stench is of a most sickening description.

To return, however, to Dr. Frankland's paper, which says nothing about the unsavory reaches below bridge, the author commences by saying that the subject of the self-purification of rivers admits of being considered from two perfectly distinct points of view, viz., from the chemical and from the biological aspects. Until recently the subject has only been discussed from the chemcal point of view. The firm conviction possessed by many that rivers undergo spontaneous purification in the course of their flow is generally based upon personal observations made upon streams in which the process appears to be going on in such a striking manner that no analytical evidence is required. All engineers are acquainted with streams which are visibly polluted at one spot, and apparently pure a few miles lower down. When such cases are further submitted to analytical tests, the latter, of course, fully confirm the previous ocular impressions. In fact, such disappearance of organic matter does take place, but when these cases of supposed self-purification are carefully investigated, it becomes very doubtful whether the phenomenon is due to anything beyond dilution and sedimentation. The careful experiments which have been made to test this point are by no means numerous. A series of investigations was made by the Rivers Pollution Commissioners of 1868 to test the point, both as regards highly polluted streams and comparatively pure ones, but in both cases their results were of a negative character, and pointed to no real purifications, i.e., destruction of organic matter, although there was distinct evidence of considerable improvement in the quality of the water through sedimentation.

Some years ago Dr. Frankland undertook a series of experiments to further test this point in connection with the Thames, which has always been regarded by some as a river possessed of most remarkable self-purifying power, and which undoubtedly often does reach London after a long flow through a cultivated and fairly populated district in a surprisingly pure state. The experiments in question consisted in taking samples of the water flowing in the river at different points on the same day, with a view to establishing whether on the whole the chemical quality of the water was improved or deteriorated during the course of its long flow. Thus, on one day, samples were taken at Oxford, Reading, Windsor, and Hampton; on another day at Chertsey and at Hampton; and on three different occasions samples were collected both at Windsor and at Hampton on the same day. The results of analysis of these various samples are recorded in a table accompanying the paper. They clearly indicate that the chemical quality of the water undergoes slight but almost continuous deterioration in flowing from Oxford to Hampton. This deterioration is in spite of a very large increase in the volume of the water, a large proportion of which gains access to the river from springs in the chalk, and is of the very highest purity. Thus, Mr. Thornhill Harrison, C.E., has determined that the total increase in volume in the Thames between Maidenhead and Thames Ditton was (exclusive of the Colne, Wey, and Mole) in April, 1884, 249,500,000 gallons per day; on July 8, 1883, 49,000,000 gallons; July 22 to 26, 131,000,000; November, 1890, 45,000,000.

After quoting several columns of figures contained in tables, unfortunately too voluminous for us to reproduce, the author goes on to point out that by their study and that of the most recent investigations, we are led to the inevitable conclusion that sedimentation is the main cause of any self-purification in river water. Of any oxidation of dissolved organic matter there is still no reliable evidence, although of course dilution, which frequently takes place on the largest scale, as in the case of the Thames, without being suspected until made the subject of a most careful scrutiny, will produce a superficial appearance of such a result. This removal of microbes by sedimentation during the flow of a river is unquestionably of great hygienic importance, and of much greater hygienic importance than the alleged oxidation of dissolved organic matter, which in itself can have no power of communicating zymotic disease. It is, however, a process which cannot be relied upon as furnishing any guarantee that harmful microbes, turned into a stream at a given point, will no longer be present in the water at any point lower down. From the numerous experiments which have been made on the vitality of pathogenic microbes in water, there can be no doubt that many forms which might have subsided, would remain alive for long periods of time, and be carried down uninjured when the river was next in flood. Dr. Frankland concludes his paper by saying that we must not allow sedimentation of microbes to cause us to relax our protective measures to exclude contamination from our streams, but on the contrary, bacteriological research clearly indicates, on the one hand, the value and importance of purifying by the very best available means all dangerous liquids, such as sewage, before admission into rivers; and, on the other hand, to submit the water drawn from streams for town supply to the most careful subsidence and filtration through sand before delivery.

[1] Abstract of a paper by Dr. Frankland, read before the Health Congress, London, Aug. 17 (reported in Engineering).

THE Summer School of Ethics and Sociology at Plymouth, Mass., the first session of which has just been held, is described in a brief illustrated article in the *Review of Reviews* for September. The article is illustrated with portraits of Professor Felix Adler of New York, Professor Toy of Harvard, and Professor Henry C. Adams of Ann Arbor.

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.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

A Suggestion to Rain-Makers.

WHILE these interesting and expensive attempts to produce rain by explosions are being carried out, it should be of special interest to science to ascertain what would be their effect when the general conditions of the atmosphere are favorable for rainfall. The promoters of these experiments show certainly great faith in their theory by selecting the worst imaginable conditions of the arid west for their playing ground; and though faith is an excellent thing, which is said to be even capable of moving mountains, and though Moses, when he was brimful of faith, produced water by striking a rock in the desert, still I am afraid these experiments may have taxed their theory too heavily by venturing to produce rain under the dry conditions generally prevailing in Texas.

Among the absolutely necessary conditions for rainfall is this, that the surface-air should not be dry; and whatever the effect of explosions may be at a higher level, the rain-drops cannot reach the ground by passing through dry surface-air, and it is not conceivable how explosions could suddenly change the dry surface-air into moist or saturated air.

But while these expensive experiments are being gone through, it might be of special interest to ascertain what would be the effect of explosions during a natural rain, or immediately after a natural rain has ceased; and I venture to predict that in the first case the concussion might give a sudden impetus to the downpour, and in the latter case likely produce an after-shower of short duration; and these results would be confirmatory of some experiments whereby I have ascertained that condensation is procurable by compression of saturated air.

A flash of lightning has often been observed to be followed by a sudden increase of downpour in its immediate neighborhood, and although this is likely due to electrical rather than mechanical causes, still I feel confident that a compression-wave passing through saturated air would result in similar effects; and whether this is actually the fact ought therefore to be ascertained while the means of doing so are at hand and while the general interest is awakened on the subject, — if I may venture to make this suggestion.

FRANZ A. VELSCHOW.

Brooklyn, Aug. 31.

BOOK-REVIEWS.

A Treatise upon Wire, its Manufacture and Uses. By J. BUCKNALL SMITH. New York, Wiley. 4°. $3.

SO far as we know, there is no other treatise upon wire which covers so much of the history and uses of the material as the one before us. The manufacture of gold wire dates back at least to 1700 B.C. The present method of drawing wire has been practised certainly in the fourteenth century in some portions of Germany. From these early beginnings our author traces the history of wire and its uses. It was not till 1565 that machine-drawn wire of home make was available in England for the making of hair-pins for Queen Elizabeth; but by 1630 the home industry had grown to such importance as to lead to the total prohibition, by Charles I., of the importation into England of foreign wire.

The uses of wire are, of course, many, and to each our author gives attention in turn. There are the electrical applications, which call for consideration of the tensile strength of the material and its conductivity; there are its uses in netting, gauze, cloth, and cards; there are the pin-making industry and the manufacture of needles; the making of umbrella and spectacle frames, of springs, cycle spokes, nails, and music strings, each of which makes it necessary to produce a wire having properties which shall suit it to the special use. The first chapter treats of iron and steel wire, the latter of which has been brought to a high degree of tensile strength, with the resulting possibility of cable-roads and improved means of transportation on wire-rope railways.

The second chapter is devoted to copper, bronze, brass, platinum, and gold wire. This leads to the consideration of very fine wires and the question of measurement and gauging, to which last subject the third chapter is given up. The fourth chapter, on electrical conductors, closes the first section of the book, which is more especially on the manufacture of wire.

The second section of the book covers the application of wire in ropes, netting, woven fabrics, fencing materials, staples, nails, etc.

The number of illustrations is large and of a character to greatly increase the value of the book.

AMONG THE PUBLISHERS.

AT the beginning of October an increase of 33⅓ per cent will be made in the amount of reading-matter printed in the New York *Critic*.

— "An introduction to the Study of Petrology: the Igneous Rocks," by Frederick H. Hatch, has recently been published by Macmillan. This is a descriptive work of small size. The author does not give any attention to the methods of examining rock sections, etc., but aims to describe the mineral constituents and internal structures of the igneous rocks, their mode of occurrence, and their origin.

— John Wiley & Sons, New York, have issued a third edition of Ludlow's "Elements of Trigonometry." The author is Lieut. Henry H. Ludlow, U.S.A., who had the co-operation of Edgar W. Bass, professor of mathematics at West Point. The requirements of the United States Military Academy determined the extent and detail of treatment. The book contains both plane and spherical trigonometry, and tables of logarithms of numbers and the trigonometric functions.

— Messrs. Longmans, Green, & Co. brought out not long ago a book by W. Hewitt, science demonstrator for the Liverpool school board, entitled "Elementary Science Lessons," which aims to carry instruction in science into lower grades of school work than any thing we remember to have seen. The first experiments are made with a sheet of window-glass, a burning candle, and a glass bottle or tumbler, which pieces of apparatus are made to serve many a useful purpose in bringing home physical truths to the infant minds during the course laid out by the author. Yet we often question the wisdom of teaching a child in the class that glass is smooth.

— The American Academy of Political and Social Science has recently published a monograph on "Recent Constitution Making in the United States," by Francis Newton Thorpe, Professor of Constitutional History in the University of Pennsylvania. The paper is a review of the work accomplished by the Constitutional Conventions of North Dakota, South Dakota, Montana, and Washington. The academy has also recently published a paper on the development of economic science in Italy, by Achille Loria, who is Professor of Political Economy and Statistics in the University of Siena.

— The Rural Publishing Company, New York, has recently brought out "The Nursery Book," which is a guide to the multiplication and pollination of plants. The author is Professor L. H. Bailey of the Cornell Agricultural Experiment Station at Ithaca, N.Y. A nursery is, by Americans at any rate, understood to mean a place where woody plants only are cultivated; but our author designates by the word an establishment for the propagation of all plants. The book aims to give an account of the methods commonly employed in the propagation and crossing of plants; of the ultimate results and influences of these methods no account is taken. The free use of competent criticism by experienced propagators was resorted to by the author while writing the book, and it is believed that all the methods described have met with approval in this country. More than half the volume is occupied by a "nursery list," which is descriptive, and covers all the plants ordinarily grown by horticulturists in this country for food or ornament.

— "The Physical Diagnosis of the Diseases of the Heart and Lungs, and Thoracic Aneurism," by D. M. Cammann, M.D., has recently been published by G. P. Putnam's Sons, New York. This book is the result of notes thrown together for use in teaching. While it is intended as a text-book on the physical diagnosis of diseases of the heart and lungs, the author has confessedly given prominence in this book to some questions which especially interested him. The author's modification of the Cammann stethoscope and the binaural hydrophone are carefully described. The averages of the measurements of the heart by auscultatory percussion are from tables made by the author's father, the late Dr. G. P. Cammann, and have heretofore been published only in part.

— D. Appleton & Co. will publish shortly a revised edition of Professor Joseph Le Conte's "Evolution and Its Relation to Religious Thought." First issued about three years ago, this work has already had four editions, and has proved to be one of the most satisfactory of the many discussions tending to establish the consistency of fundamental religious beliefs with the known laws of development. Three new chapters are incorporated, one of them relating to matters upon which the author states his mind was not fully clear when the book was first written, and he has been "willing to wait and let the leaven work."

— "First Lessons in Arithmetic," of Appletons' Standard Arithmetics, by Andrew J. Rickoff, A.M., LL.D., has just been issued by the American Book Company. In the first steps all the exercises and problems given involve numbers not greater than ten, a modification of the Grube method being employed. Illustrations and diagrams are introduced with a view of making the first steps concrete with every number studied. Part II. deals with units and tens, and here the method, so far as applicable, is the same as that pursued with the digits; and so on. In all parts of the book a proper balance is maintained between two much explanation and too little. A large number and variety of exercises and appropriate problems are provided, and needed explanations and illustrations are given.

— Several new leaflets have just been added to the general series of "Old South Leaflets," issued by the directors of the Old South studies in history, and furnished by D. C. Heath & Co., Boston. All of them are connected with the English Puritan period, and are of value in the study of the development of our own political liberty and of our political system. They include the "Petition of Right," presented by Parliament to King Charles in 1628; the "Grand Remonstrance;" the "Solemn League and Covenant," which gave the name of "Covenanters" to the Scottish Protestants; the "Agreement of the People;" the "Instrument of Government," under which Cromwell began his government; and "Cromwell's First Speech to his Parliament." These "Old South Leaflets," furnishing these famous original documents, heretofore almost inaccessible to the mass of the people, for the few cents covering their cost, are invaluable. There are now nearly thirty in this general series.

— "The Modern Antipyretics: their Action in Health and Disease," by Isaac Ott, M.D., has recently been published by E. D. Vogel, Easton, Pa. The process of fever is more studied of late than ever, and the number of antipyretics has been considerably increased. The maintenance of a constant temperature in the human body is due to the rate of loss of heat being equal to that at which it is generated. The ordinary theory is that in the case of fevers the rate of generation of heat is increased. While this is primarily true, i.e., the fever state is set up by an increase of the rate of heat generation, it is now maintained by a respectable minority that fever is not due to a fire which is kept up by an unduly rapid oxidation of the constituents of the body, but that the increase in temperature is due to a disturbed condition of the means of the dissipation at the surface of the body of the heat generated within. Dr. Ott attacks the two free use of most antipyretics, and recommends the application of such means as will allow the internal heat to escape, as it were.

— Messrs. Macmillan & Co. have commenced the publication of a "Dictionary of Political Economy," which bids fair to be a work of real importance. The first part, containing 128 pages, extends as far as the word "bede," the volume being an octavo with two columns on a page. The editor is Mr. R. H. Inglis Palgrave, and the writers in this first part comprise a large number of the best qualified men in England and Scotland, with several in America and continental Europe. The articles are intended to cover not only every important topic in economic science, but also many legal and political subjects which it is necessary for economists to know about. Brief biographies of economic writers are given, with some notice even of men like Aquinas, who have treated economics only incidentally. The topic accorded most space in this part is banking; but almost every subject having an economic bearing is dealt with at greater or less length. Judging by this number alone, we should say that the theoretical topics were in danger of being insufficiently treated; but this may be remedied in future numbers. The work is to be completed in twelve or fourteen parts, issued at intervals of about three months, at one dollar each.

— Messrs. S. C. Griggs & Co. announce for early publication "A Study of Greek Philosophy," by Ellen M. Mitchell, with an introduction by W. R. Alger. The author endeavors to explain what is meant by philosophy, discussing the character and source of the Greek philosophy, showing whence came the beginnings of Greek religion and culture. The earlier schools of thought, including the Pythagorean, the Eleatic, the Atomistic, and others leading up to the school of the Sophists, receive critical treatment, short biographical sketches of their principal exponents being given. The chapters on Socrates and the Socratic philosophy are unusually full, the life, character, and fate of the great philosopher being told; and Platonic and Aristotelean philosophies are explained.

— Messrs. William Blackwood & Sons have published a pamphlet by Professor James Seth on "Freedom as Ethical Postulate," which may interest some of our metaphysical readers. The writer by no means agrees with thinkers like Professor Paulsen that the question of free will belongs to the region of metaphysical antiquities: on the contrary, he holds that its solution is necessary to the establishment of a true moral philosophy. He rejects the theory of determinism, and also that of Kant, with its distinction of noumenon and phenomenon, though he agrees with Kant in thinking that our moral consciousness gives us immediate evidence of freedom. The question, then, is how to reconcile this consciousness of freedom and responsibility with the law of causation; but in attempting this task we cannot think that Professor Seth is much more successful than other thinkers who had preceded him. His essay, however, contains some useful hints, and sets forth the present state of the problem very clearly in a small space.

— The *Century Magazine* will celebrate the 400th anniversary of the discovery of America by publishing a "Life of Columbus" written especially for that magazine by Emilio Castelar, the Spanish orator, statesman, and author. The work is written in Spanish, and will be carefully translated. Señor Castelar, whose interest in and admiration for America are well known, has made a careful study of the new historical material bearing upon the subject, and it is said that his papers will be very richly illustrated. Other articles dealing with the discovery of America are in course of preparation for the magazine. In view of the present timeliness of the subject, the same magazine has arranged to print during the coming year an important series of articles on the general subject of agriculture and the Government's relation to the farmer. Among the topics to be treated are "Agricultural Possibilities of the United States," "The Farmer's Discontent," "What the Government is doing for the Farmer," etc. Mr. J. R. Dodge, statistician of the Agricultural Department, Mr. A. W. Harris, of the same department, Professor Brewer of Yale, and others, are among the writers.

— "Optical Projection," by Lewis Wright, was recently published by Longmans, Green, & Co., New York. The author is well known by his excellent treatise on "Light." When a boy Mr. Wright was presented with a projecting lantern of considerable pretensions, a circumstance which resulted in optical projection being a hobby with him for most of the time since. Slides were formerly all that could be used, but as time went on our author found pleasure in projecting on the screen the progress of actual experiments. The beautiful phenomena of polarized light also interested him, and the making of them more spectacularly imposing had due attention. The author was intimately associated with one of the leading opticians of London, and having every facility and a great love for the work, has added much to this fascinating method of making lectures attractive. It should be stated that the experiments are most of them physical or chemical.

— Under the auspices of the Boston Society of Natural History, there has been issued a series of "Guides for Science Teaching." No. VIII., entitled "Insecta," is by Alpheus Hyatt and J. M. Arms. This guide is intended to be a series of replies to questions which have arisen in the minds of its authors while teaching. The book is well illustrated, and may prove useful to those for whom it is intended, — teachers and not students. There is something confusing about the arrangement of the book, even repelling, but that conscientious work was put into its compiling no one can doubt. The publishers are Heath & Co., Boston.

— "Telephones: their Construction and Fitting," by F. C. Allsop, just published by E. & F. N. Spon, New York, is a thoroughly practical book. It has to do with wires, magnets, and the various parts of microphones and telephones, so that he that reads may put the parts of a telephone line together properly, and may find the cause of and remedy the various faults which so often occur. The book is especially intended for the use of such persons as wish to go into the construction of private telephone lines.

— The introduction into the high schools of a more careful study of physics, in consequence of the advancing requirements of the college entrance examinations and the increasing importance of this branch of science, has led to the writing of a number of modern text-books, among which those by Dr. Alfred P. Gage are favorably known. The "Physical Laboratory Manual and Note Book" (Boston, Ginn & Co.) aims to give just those details which the pupil should observe, unencumbered so far as possible with matter pertaining only to the construction of the apparatus. The book is not a guide to the construction of apparatus, which subject is treated in "Physical Technics" by the same author.

— F. A. Davis, Philadelphia, has published a second edition of the "Text-book of Hygiene," by George H. Rohé, M.D. Dr. Rohé is connected with the College of Physicians and Surgeons, Baltimore, and is well known among scientific men. Air and water naturally come in for first consideration in this book. Under air is considered not solely the effect of any impurities that may be contained in it, but also what influences, good or bad, are involved in changes of the atmospheric pressure, temperature, and humidity. In this connection the author is able to show the worthlessness of a superstition of surgeons that it is best to perform operations when the barometer is rising. The diagrams showing the variability of the fatality of certain diseases with the season are especially interesting. The moderation of the author throughout is pleasing, and is likely to lead to his book having even greater influence in the future than in the past. After air and water, foods are discussed. The use of alcoholic beverages our author discourages, though he appreciates their use under some circumstances, and is sufficiently scientific to comprehend the facts so far as known. Alcohol is a true respiratory food, not that it contributes nutritive material to the body, but it saves that which is stored up for other uses, by furnishing easily oxidizable material for carrying on the respiratory process and supplying animal heat. Chapters are devoted to the soil, sewerage, and the construction of habitations respectively, at least in the last case so far as any thing about them has an effect on the physical well-being of their inmates. The school-house is next considered, and due attention is paid to the effect on the health of school children of the air they breathe, the light they read by, and the positions they assume at their desks. The soldier's health, that of the prisoner and the factory operative, each have consideration. The maintenance of good health through indulging in due exercise and in cleanly habits, and the use of well ordered clothing, are subjects treated before our author touches on the disposal of the dead and the modern theories of contagion and infection. There are chapters on naval hygiene, by Medical Director Albert L. Gihon, U. S. N., and on quarantine, by Surgeon Walter Wyman, U. S. M.-H. S.

— The closing volume (III.) of the fourth edition of Chambers's "Handbook of Descriptive and Practical Astronomy," which has been issued during the past year or two by the Clarenden Press (New York, Macmillan), is on "The Starry Heavens." It might, perhaps, be said that the whole work is on the starry heavens, but while the other volumes are devoted to the means and methods of astronomical work, this volume describes what can be seen in the heavens, in contradistinction to how to see it. Perhaps the pole-star is that most familiar to most persons, at least the one to which more persons can give a name than to any other; so starting from this the author passes on to tell how the pole-star has not always been the same, and of its possible recognition by the ancient Egyptians. The classification of stars according to magnitude is described, the results of determinations of stellar parallax, and the consequent distances of a few fixed stars, the modes of designating stars, their proper motion, and the distribution of stars in space, are among the subjects treated in the early part of the volume. Several chapters are devoted to multiple and variable stars and to clusters and nebulæ, giving in each case some account of their discovery and of the problems to which their existence has given rise. The Milky Way and the constellations are treated in two chapters. The main portion of the book is taken up with the valuable catalogues of stars which make it so useful to all astronomers, and, since their needs have been specially considered, to the many amateur astronomers, possessors of telescopes of low power. Additional objects have been described as types in connection with the chapters on clusters and nebulæ. Most important new features are the photometric catalogue of naked-eye stars and the descriptions of ways of finding the constellations during the different months of the year.

— *The Political Science Quarterly* for September is equally strong on the American and the foreign side. Frederic Bancroft of the United States State Department describes "The Final Attempts at Compromise" during the winter of 1860–61. He shows that none of the proposed solutions of the slavery question could possibly satisfy even the more moderate representatives of both sections, and that none of the proposed compromises could have settled the question between the free and the slave States. Thomas L. Greene discusses "Railroad Stock-Watering" and railroad rates. He maintains that high dividends are not usually associated with high rates, and that the increase of the capital stock of a railroad is no sufficient ground for governmental interference to reduce rates. He distinguishes between innocent stock-watering, which seeks to bring railroad capitalization into accord with the laws of finance, and that which is not innocent. The latter, he thinks, can best be checked by enforced publicity, as is done in New York. Professor F. J. Goodnow of Columbia College traces the development of "The Writ of Certiorari" in England and the United States. He shows how the province of the writ has been modified and its application extended until it has become the chief means of protecting private rights against the arbitrary action of administrative authorities, the ordinary courts assuming that control over the administration which on the continent of Europe is vested in special tribunals. Three articles deal with foreign questions. Professor Richard Hudson of the University of Michigan takes "The Formation of the North German Confederation" as the text for an acute and suggestive criticism of all the legal theories regarding the federal state. He demonstrates that the formation of such a state is not susceptible of juristic explanation. Professor Ugo Rabbeno of Bologna, one of the best of Italy's younger economists, gives an extended *résumé* of "The Present Condition of Political Economy in Italy." This article contains a mass of information not elsewhere accessible, and will therefore be invaluable to all students of economic science. Finally Professor W. J. Ashley of Toronto University, Canada, subjects Gen. Booth's scheme for the social regeneration of England through Salvation Army "colonies" to a destructive scientific criticism. The "Reviews" and "Book Notes" contain about forty titles.

— John R. Spears, the author of a recent article on the devastating sand-waves at Capes Henlopen and Hatteras, has made a reputation as a traveller in out-of-the-way places. An article by Mr. Spears on "Odd American Homes" in the September number of

Scribner's Magazine is the result of extended observation, especially in the West and South-west, where Mr. Spears made a journey at the time of the Oklahoma boomer excitement. It is illustrated from photographs made by the auther of some very unique frontier dwellings. There has been a great deal of discussion during late years in regard to shortening college courses, and higher university work. Professor Josiah Royce of Harvard, in an article in the same number on "Present Ideals of American University Life," makes a plea for the raising rather than lowering of the university standard, and sets forth the past and present college methods, showing the lines on which he thinks the great American university of the future should work. In the same issue of the magazine Mr. James Ricalton, writing of the wonderful old ruins of monuments and shrines at Anuradhapura, the City of the Sacred Bo-Tree in Ceylon, says: "From the days of the mound builders down to the Eiffel tower, man has shown himself to be a monument-erecting being; the Christians have their cathedrals, the Mohammedans have their mosques, and the Buddhists have their shrine-tombs, designated differently in different countries as pagoda, tope, and dagoba. The pagodas of China are entirely dissimilar to those of Burmah, and the dagobas of Ceylon are quite unlike those in either country; yet all serve the one purpose of relic sepulture. They are not altogether a thing of the past; they are still erected near the temples; but those of modern construction are small and unimportant when compared with those that have withstood biennial monsoons for two thousand years; even their half-buried ruins are stupendous."

—It will be remembered that the edition of "Catalogue of Minerals and Synonyms," by Thomas Egleston, Ph.D., which was originally published by the government, was soon exhausted, and that a new edition was promised by John Wiley & Sons, New York, some months since if sufficient subscriptions should be received to justify the expense. This new edition is now received. This catalogue was commenced in 1867 for use in arranging the collections of the School of Mines of Columbia College, but the press of other duties caused such delays that practically a new catalogue was begun and finished twenty years later; and it is this that is given to the public. The need of a collection of synonyms has been shown by the quick way in which the government edition was seized upon, and we doubt not the New York publishers will be duly rewarded for bringing out this new edition ($2.50).

—In Stewart's "Plane and Solid Geometry," just published by the American Book Company, there are several features worthy of notice. One prominent feature is the close adherence to the principle of association, each book treating of only one subject, and each section of one subdivision of the subject. Another good feature is the system of so grading the exercises and presenting them in such order that their successive solution should tend to

Publications received at Editor's Office, Aug. 5-Sept. 1.

ANDERSON, E. L. The Universality of Man's Appearance, and Primitive Man. Edinburgh, Douglas (Cincinnati, Clarke). 28 p. 8°. 25 cents.
DOWIE, M. M. A Girl in the Karpathians. New York, Cassell. 301 p. 12°. $1.50.
EGLESTON, T. Catalogue of Minerals and Synonyms. New York, Wiley. 378 p. 4°. $2 50.
LANGLEY, S. P. Experiments in Aerodynamics. Washington, Smithsonian Inst. 115 p. f°.
RICKOFF, A. J. First Lessons in Arithmetic. New York, American Book Co. 150 p. 12°. 36 cents.
SETH, James. Freedom as Ethical Postulate. Edinburgh, Blackwood. 48 p. 8°.
SMITH, J. Bucknall. A Treatise upon Wire, Its Manufacture and Uses. New York, Wiley. 347 p. 4°. $3.
STEWART, S. T. Plane and Solid Geometry. New York, American Book Co. 406 p. 12°. $1.12.
WINSLOW, I. O. The Principles of Agriculture for Common Schools. New York, American Book Co. 152 p. 12°. 60 cents.

cause a constant growth in the power of thought, analytic and synthetic. It may be noted also that a definite plan is followed with respect to diagrams: lines mentioned in the statement, for instance, are solid, unless planes intervene; while all additional lines, mentioned in the construction, are dotted, the more important lines being heavier than those of lesser importance. Moreover, the diagrams and their demonstrations, throughout the volume, are invariably so placed that they may both be seen without turning a leaf — either on the same or on facing pages.

— A third edition has recently appeared of Frazer's "Tables for the Determination of Minerals." This book is based, as is well known to many *Science* readers, on one by Weisbach, which was first published in 1866. The purpose is to aid the student in determining minerals by their physical properties as distinguished from the chemical reactions which they give. That it is possible so to arrange tables that it shall be in the main possible, by their use, for the student to determine a mineral from its color, lustre, streak, hardness, crystalline form, and cleavage, has been shown by the reception which this book has had through its various editions. Many know how much that was antiquated in chemical science has clung to the text-books of mineralogy, and it was one of Dr. Frazer's aims in the production of this new edition of his "Tables" to eliminate all of this old and substitute formulas, etc., more in accordance with the present state of chemical science, The book is well known, so it seems unnecessary to commend it to our readers more than by saying that this edition is to a great extent quite new (Philadelphia, Lippincott).

— The American Book Company has published "The Principles of Agriculture for Common Schools," by J. O. Winslow. This is quite a departure from the usual run of school books, and will interest many who wish to see the elements of science taught in the schools. The book is not limited to what would usually be called agricultural science, but contains snatches from all branches of science which have a bearing on agriculture.

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SCIENCE

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THE CURE OF CONSUMPTION.[1]

No words of mine are required to impress upon you the great importance of this subject, to express the intense interest that is universally taken in it, or to point out the far-reaching influence its public establishment will have upon scientific investigation. But it is, perhaps, necessary for me to say that I fully recognize the grave responsibility that rests upon any one who makes the statements I am about to make, and that I am completely justified in accepting that responsibility. Perhaps it may be within the recollection of some of those present that at the Birmingham and Manchester meetings of the association in 1886–87 I read papers giving the results of a series of investigations on consumption and chest types. I showed in the former paper that consumption was directly produced by the conditions that tend to reduce the breathing capacity below a certain point in proportion to the remainder of the body, and contended that it could be both prevented and completely recovered from by the adoption of measures that were based upon that interpretation of its nature. In the latter I adduced evidence that proved that the size and shape of the chest after birth solely depended upon the conditions to which it was subjected, that there was the same relationship between the size and shape of the other parts of the body and the conditions to which they were subjected, and that this law obtained in the animal and vegetable kingdoms. The research, as a whole, showed that there was a complete series of types that had on the one hand extreme consumption, and on the other the finest type of health, directly produced by the conditions to which they had been submitted. And I referred to the immense importance of the issues that were raised, both from a practical and scientific point of view.

At that time the evidence was mainly derived from experiments, although I had some most valuable and significant practical experience, and I found the general opinion was that it would be extremely difficult, if not impossible, to practically apply that knowledge. Since then, however, the practical evidence of the relationship between conditions and types of chest has been irrefutably established at the Polytechnic. By the application of that knowledge in the ordinary routine of daily life, the members of the Polytechnic Physical Development Society, although engaged for many hours daily in all sorts of trades and occupations, some of them under very unfavorable conditions, have shown how greatly the chest girth, its range of movement, the vital capacity, and the power of inspiration and expiration can be increased. Last year, at Leeds, I gave the measurements of one hundred members. If you will refer to the report you will find the average increase of the chest girth was $1\frac{3}{4}$ inches, that of the third class being $1\frac{1}{4}$ inches, the second $2\frac{1}{8}$ inches, and the first class $3\frac{5}{8}$ inches. At a subsequent examination for the society's gold medals and certificates the first three members had obtained an increase of $6\frac{1}{2}$, 5, and $4\frac{5}{8}$ respectively, and although some of our best members are constantly leaving the Polytechnic, and new ones joining us, I am glad to say there has been a further average increase of one-quarter of an inch in all classes. Many of the members are engaged in the trades that have a high rate of mortality from consumption, and not a few of them would have long been in the ranks of the consumptives had it not been for the efficacy of the directions given them by the society,— that is to say, the practicability and certainty of the measures that are necessary to secure the prevention of consumption have been fully demonstrated.

Whilst one part of the work has been practically applied at the Polytechnic, the practical application of the other has been equally successful in the amelioration and, where the disease was not too extensive, the cure of consumption. I cannot enter into medical details here, but I may state that by the cure of consumption I mean the possession and appearance of sound health, natural breathing from base to apex, a well-formed and fairly developed chest, a good range of movement, and vital capacity that have stood at least a twelve months' test. The cases that were referred to at Manchester in 1887 as having completely recovered remain well, and those that have subsequently recovered went through last winter without giving the slightest indication of a relapse. There has been no relapse in any of these cases of cure, and no failure. Up to the present the mortality of all the cases has been under ten per cent, and has been limited to those who were most extensively diseased, and who were, in fact, *in extremis*. There are others who have derived great benefit, and some of them will ere long take their places in the ranks of the cured. One of the latter has stolen a march upon me. He presented himself for life assurance, was accepted as a first-class life, and obtained a reduction in his premium He is unquestionably well, but he would not allow me my twelve months' test. There is not a sufficient number of cases to compare with the statistics obtained at the Polytechnic, but I may say the increase in the chest girth ranges from $1\frac{1}{2}$ inches to over 4 inches. We have chest girths of over 38 and 39 inches, the range of movement varies from 3 to 6 inches, and the vital capacity greatly exceeds in some cases Hutchinson's standard of health.

I have now shown you that the results that had been experimentally obtained have also been equally well obtained in the practical application of that research, that each part of the investigation confirms the other, and that they together form a complete and harmonious whole. Consequently I have also shown you that we now have before us and within our grasp the real cure for consumption, that we can effectually prevent its production, and that by united and continuous action in both directions we can, ere long, practically remove this curse of civilization from our midst.

What steps are to be taken to secure the great benefits of this advance in knowledge? Let me, in the first place, remind you that consumption is a disease of civilization, a part of the process of evolution by which an adjustment is made between the body and the work it has to perform under the ever-changing conditions of advancing civilization, by the re-

[1] An address by Godfrey W. Hambleton, M.D., president of the Polytechnic Physical Development Society, at the meeting of the British Association for the Advancement of Science, Cardiff, August, 1891.

moval of those who have a body incapable of that work, and that it is directly produced by the habits and surroundings that tend to reduce the breathing capacity below a certain point in proportion to the remainder of the body. Obviously, the first thing that has to be done is to prevent the production of this disease, and for that purpose we must see that the body is used to the extent its size demands, and that the work it has to perform is carried on under conditions that are favorable to the body, — that is to say, we must so arrange our habits and surroundings that their tendency as a whole is to develop the lungs. Each act of man, each factor in his environment, tends either in his favor or against him. We must avoid as far as possible — and where that is not practicable we must counteract their action — those that tend to reduce the breathing capacity. Close, badly-ventilated, or hot rooms, the inhalation of any kind of dust, the habit of taking small quantities of alcohol (termed "nipping"), stooping, positions that cramp or impede the full and free movement of the chest, the corset or tight-fitting clothes, overloading the body with clothes, etc., are examples of such conditions. And we must place ourselves as far as possible under the conditions that tend to develop the lungs. We should spend as much time as possible in some form of active exercise in the open air, live in rooms that are in direct free communication with the external air night and day, summer and winter, and keep their temperature down. We ought to have the clothing quite easy over the chest at full inspiration, wear wool next the skin, take a tub daily, hold the body erect with the chest thrown well forward and the shoulders held well back, get into the habit of taking deep inspirations followed by full expirations, and breathe through the nose. And we should go in for singing, swimming, gymnastics, — Ling's system by preference, — and for one or, better still, several forms of athletic sports, rise early, and maintain the temperature of the body by muscular exercise. I have briefly indicated the conditions that are favorable or unfavorable to lung development, and to that I will only add that measurements by the tape, the spirometer, and the manometer should be regularly taken, recorded, and compared with the standards that indicate a fully developed chest, and that it is the plain duty of each one of us to see that he stands well in that respect, for we can protect ourselves from the possibility of an attack of consumption by securing and maintaining a lung capacity far above the point at which the disease originates.

The second direction in which we must take action, if we mean to remove this curse of civilization from our midst, is to recognize early, and that promptly and adequately, those who have the great misfortune to be its victims. This is the state with which we have to deal here. The lungs are being progressively destroyed by a process of irritation caused by more work being thrown upon them than they are able to effect, and this inability has been produced by their having been and still being subject to conditions that tend to reduce their capacity; and, further, during the progress of these events, the other organs have become involved by attempting to perform compensatory work, with the result that the general health is more or less seriously compromised. Consequently, in order to adequately deal with this state of things, we must treat consumption upon the following principles: To establish an equilibrium between the amount of interchange required to be effected and that effected, to enable the other organs of the body to perform their ordinary functions, to restore to the lungs their power of adjustment to their external conditions, and to obtain the above without producing indications of friction. That is, in other words, we must arrest this process of irritation, restore the general health, and develop the lungs to the required amount, in order to effect the cure of consumption. I will now briefly indicate the method of applying the principles above laid down. We must, to arrest this process of irritation, remove the conditions that impede the effecting of those interchanges by placing the patient under conditions that tend to develop the lungs, and make good any deficiency that may remain by causing compensatory action by one or more of the other organs. We shall proceed with measures for the restoration of the functions of any organ that may have been deranged, and when we have obtained the arrest of the disease and effected an improvement of the general health we shall begin to develop the lungs. We must carefully select appropriate medicines and measures for each purpose we have in view, use them at the right time and to the right extent, and watch their effects, so that if there be any indication of friction we may at once effect the necessary modification or use some other medicines or measures for that purpose.

It is easy to cure consumption at the commencement, even when both lungs are affected. It can be cured when there is a large amount of disease, and it may at least be ameliorated when both lungs are extensively diseased. I speak from practical experience, and I for one will not attempt to place a limit upon the great power of Nature when all her forces are called forth and aided.

The links of evidence slowly forged by men who have gone and by others still with us I have put together. Test the chain thus formed where and how you please, and you will find that it is complete and unbreakable. We have performed our part of this work, and in the name of those who have taken part therein I now call upon you to give effect to it by uniting together in the great work of suppressing consumption.

PROGRESS OF PREVENTIVE MEDICINE.[1]

UNPRECEDENTED progress in human knowledge characterizes the present century, and has not been wanting in preventive medicine. It is, however, during the last half of it that advance has been most remarkable, whilst it is in a later part of that period that it has so established itself in the popular mind as to have passed from the region of doubt and speculation into that of certainty. It is now pretty generally understood that about one-fourth of all the mortality in England is caused by preventable disease, that the death-rate of large communities may be reduced much below that at which it has been wont to stand, that the average duration of life may be made to approximate nearer to the allotted fourscore, and that the conditions of living may be greatly ameliorated. The chief obstacles to improvement have been ignorance and want of belief. A better knowledge of the laws of life and health, a more rational comprehension of the nature and causes of disease, are gradually but surely entailing improvement in the conditions of living and in the value of life, and the diminution and mitigation, if not extinction, of morbid conditions which have in past times proved so injurious or destructive to life. Such are the subjects contemplated in the work of this section, and as far as time permits the most interesting of them will be discussed, Those selected are of great importance in their relations to public health; let us hope that observers who have formed their opinions from experience in other countries and under different circumstances may throw new light on them.

In the brief space of time at my disposal it would be impossible to give a continuous outline of the progress of preventive medicine during the past, or to trace its growth and development out

[1] Abstract of the inaugural address before the Section of Preventive Medicine of the Congress of Hygiene, in London, England, Aug. 11, 1891, by Sir Joseph Fayrer, K.C.S.I., F.R.S., president of the section (from Nature of Aug. 20).

of ignorance and superstition to its present well-established foundation on a scientific basis. It is of happy augury for mankind that the subject of public health is now fairly grasped by popular sentiment, and that, though ignorance, opposition, and vested interests still contest the ground, progress is sure, and the light of science is illuminating the dark places. It is now better appreciated than it ever has been, that the causes which induce disease and shorten life are greatly under our own control, and that we have it in our power to restrain and diminish them, and to remove that which has been called "the self-imposed curse of dying before the prime of life."

It is, indeed, only recently that the resources of medical science have been specially devoted to the prevention as distinguished from the cure of disease, and how far successfully I hope in a few words to show, whilst I trust the proceedings of the various sections of this congress will indicate how much remains to be done. Did time permit, I might illustrate the progress of preventive medicine by contrasting the state of England with its population of more than 29,000,000 during the Victorian age with the England of the Elizabethan age with its 4,000,000. I might remind you of the frightful epidemics which had devastated the land, in the forms of black-death, sweating sickness, plague, petechial typhus, eruptive fevers, small-pox, influenza, and other diseases, such as leprosy, scurvy, malarial fever, dysentery, etc., of the wretched mode of living, bad and insufficient food, filthy dwellings, and ill-built towns and villages, with a country uncultivated and covered with marshes and stagnant water (according to Defoe, one-fifteenth part of England consisted of standing lakes, stagnant water, and moist places, the land unreclaimed, and with the chill damp of marsh fever pervading all). The homes of the people were wooden or mud houses, small and dirty, without drainage or ventilation, the floors of earth covered with straw or rushes, which remained saturated with filth and emitting noxious miasmata. The streets were narrow and unpaved, with no drains but stagnant gutters and open cesspools, while the food was principally salted meat with little or no vegetables. To this may be added a large amount of intemperance and debauchery. As it is, I can only just allude to them. In such conditions disease found a continual nidus, and by a process of evolution assumed the various epidemic forms which proved so destructive to life. Some of these have gone, let us hope never to return, and the conditions which fostered if they did not cause them have gone also. Can we venture to hope that it will be the same with those that remain? Our immunity during the last diffusion of cholera gives some ground for thinking it may be so, if, indeed, the legislature and popular intelligence should be of accord on the subject.

If we turn to the present, we find that great improvements have gradually been made in the mode of living; the houses are better constructed, the drainage and ventilation are more complete, the land is better cultivated, and the subsoil better drained; marsh-fever and dysentery, at one period so rife, are unknown, and leprosy has long since disappeared. The death-rate is considerably reduced, and the expectancy of life enhanced. Water is purer, food is more varied and nutritious, clothing is better adapted to the climate, the noxious character of many occupations has been mitigated, and the mental, moral, and physical aspects of the people altogether improved; education is general, a better form of government prevails, and the social conditions are far in advance of what they have been; but still the state of our cities shows that improvement is demanded, and one object of this congress is to point out why and how this may be effected, not only in this country but throughout the world.

If we inquire into the effects of certain well-known diseases, we find that they are less severe in their incidence, if not less frequent in their recurrence. With regard to small-pox, since the passing of the first vaccination act in 1840, the death-rate has diminished from 57 2 to 6.5 per 100,000 for 1880–84, though for the five years 1870–74 it was 42.7, thus showing that there was still much to be learnt about vaccination. Enteric fever was not separated from typhus-fever before 1869, but since then the death-rate has decreased from 0.39 to 0.17 per 1,000, and it has been shown that this improvement was synchronous in different parts of England with the construction of proper drains. The diminution in the death-rate from typhus-fever is quite as striking, and this also is shown to have run parallel with improved sanitation in more than one large town. The death-rate from scarlatina fluctuated between 97 and 72 per 100,000 between the years 1851 and 1880, and though it has diminished considerably of late years (17 per 100,000 in 1886), a corresponding increase in the death-rate from diphtheria has taken place. This may be due in part to a better differentiation of the two diseases. In 1858 it was reported that phthisis killed annually more than 50,000 people. The death-rate from this disease has not decreased very much for England and Wales, but it has done so in some large towns, notably in Liverpool; and Dr. Buchanan and Dr. Bowditch of Massachusetts both showed a striking parallelism between the diminution of the death-rate from this cause and the drying of the soil resulting from the construction of sewerage works.

Cholera first appeared in England in 1831, and there were epidemics of it in 1848–49, 1853–54, and 1865–66, but the number of deaths diminished each time it appeared, and though it has been present since, it has never reached the height of an epidemic. This is fairly attributable to local sanitary rather than to coercive measures. Preventable disease still kills yearly about 125,000. Towns, villages, and houses are still built in an insanitary way; the death-rate is still higher and the expectance of life lower than it should be, and though we have got rid of the terrible plagues of the middle ages, yet in this century, now closing, other epidemics have made their appearance. Cholera has four times visited us; fevers, eruptive diseases, and diphtheria have prevailed; influenza has appeared several times, even recently, and after leaving us last year, only to return with renewed virulence, caused in the United States a mortality almost equal to that of the plague.

Much has been done, and a great deal of it in what has been called the pre-sanitary age, but much remains to be effected. Let us hope that the future may be more prolific of improvement than the past; international philanthropy seems to say it shall be so. That we can exterminate zymotic disease altogether is not to be expected, but there cannot be a doubt that we may diminish its incidence, and though we may never be able to reach the "*fons et origo mali*," yet we can make the soil upon which its seed is sown so inhospitable as to render it sterile.

The scope and objects of preventive medicine are not limited to the removing of conditions which give rise to zymotic disease, nor even of those which compromise otherwise the physical welfare of mankind, but should extend as well to a consideration of the best means of controlling or obviating those which, attending the strain and struggle for existence, involve over competition in various occupations, whether political, professional, or mercantile, by which wealth or fame is acquired or even a bare livelihood is obtained, and under the pressure of which so many succumb, if not from complete mental alienation, from breakdown and exhaustion of the nervous system, which give rise to many forms of neurotic disease and add largely to the numbers of those laid aside and rendered unfitted to take their due share in the natural and inevitable struggle for existence. Or I might point to the recrudescence of those psychical phenomena manifested by the so-called hypnotism or Braidism, morbid conditions arising out of the influence of one mind upon another. This is a subject which demands not only further investigation, but great precaution as to its application, and claims the watchful notice of preventive medicine on account of the dangerous consequences which may ensue from it.

Again, the abuse of alcohol, opium, chloral, and other stimulants and narcotics, and the evil consequences which may result therefrom, is also a subject worthy of consideration.

The possible deleterious influence of mistaken notions of education, as evinced in the over-pressure which is exercised upon the young, the predominance of examinations, their increasing multiplication and severity, and the encouragement of the idea that they are the best test of knowledge, whilst true mental culture is in danger of being neglected, and physical training, if not ignored, left so much to individual inclination, — this is another subject which demands the jealous scrutiny of preventive medicine, whose duty it is to safeguard the human race from all avoidable causes of either physical or mental disease.

Though preventive medicine in some form has been practised since the days of Moses, yet it has received but little recognition until a comparatively recent period. When science developed and observation extended, medical men and others became impressed with the influence of certain conditions in producing disease, and thus it was forced upon the public conscience that something must be done; and when philanthropists like John Howard devoted life and property to the amelioration of such awful conditions as existed, — e.g., in our jails, where the prisoners not only died of putrid fever, the result of ochletic causes, but actually infected the judges before whom they came reeking with the contagion of the prisons, — rude sanitary measures gradually came into operation and partially obviated these evil conditions. But it was not before the middle of this century that any scientific progress was made; it was when Chadwick, Parkes, and others initiated the work by which they have earned the lasting gratitude of the human race that preventive medicine became a distinct branch of medical science.

The sanitary condition of towns and communities is not dependent on the views or exertions of individuals alone, for they are and have been for the last fifty years largely cared for by the legislature, and a variety of acts have been passed which deal with questions concerning the public health. Indeed, were all the provisions enforced, little would remain to be desired on the part of the executive government; but as many of them are permissive, not compulsory, the benefit is less complete than it might be. The old difficulty of prejudice combined with ignorance still too often stands in the way, and, despite evidence which on any other subject would be conclusive, the most obvious sanitary requirements are often ignored or neglected. Many thousands of lives have been saved by the sanitary acts now in force; but there is little doubt that more thorough organization under State control, as under a minister of public health, would have most beneficial results, and would save a great many more. We must acknowledge, however, that we are much indebted to the action of the Local Government Board, under whose able administration the most crying evils are gradually being rectified. Through the wise precautions enacted by it against the importation and diffusion of epidemic disease, when other parts of Europe were affected by cholera, this country escaped, or so nearly so as to suggest that it was to sanitary measures we owed our immunity. That there is something in the nature of epidemics which brings them under the dominion of a common law as to their extension seems certain; that there is something about them we do not yet grasp is equally true, but it is as surely the case that local sanitation is the preventive remedy as it is that coercive measures to arrest their progress are unavailing.

Under the improved system of sanitary administration which now obtains, and is gradually developing to a greater state of perfection, the sanitary administration of every district in the country is intrusted to the care of duly qualified health officers — a system from which excellent results have already accrued, and from which better still may be anticipated. The records of the past fifty years prove the influence exerted by sanitary measures on vital statistics. The first reliable tables from which expectancy of life may be derived show that in 1838 to 1854 it was, for males 39.91 years, for females 41.85 years; by the tables of 1871 to 1880 it had increased to 41.35 for males and 44.66 for females. It is shown also that the expectation of life increases every year up to the fourth year, and decreases after that age. For males up to nineteen years it is higher by the last tables, but after that age it is higher by the old table; for females it is greater by the new table up to forty-five, but after that age it is less. The improved sanitation saves more children's lives, but the conditions of gaining a living are harder than they were at the time of the first table, which accounts for the expectancy of life for adult men being less. Women remain more at home, where the better sanitation tells, and are not subject to quite the same conditions as men, so that their expectancy of life is greater than by the old tables up to the age of forty-five. A further proof of the effects of sanitary work is a decreased death-rate. Let us compare the death-rates of England during the past times with the present; whether they be equally significant for other countries I cannot say, but these, at all events, sufficiently prove the point in question: 1660–79, 80 per 1,000; 1681–90, 42.1; 1746–55, 35.5; 1846–55, 24.9; 1866–70, 22.4; 1870–75, 20.9; 1875–80, 20.0; 1880–85, 19.3; 1885–88, 18.7; 1889, 17.85. In some parts of England, where the main object is the recovery or maintenance of health, the death-rate is down to 9 per 1,000, while in others, where the main object is manufacture and money-making, it is as high as 30 per 1,000.

Nowhere, I think, have the beneficial results of sanitary work been better illustrated than in India during the past thirty years. A royal commission was appointed after the Crimean war to inquire into the sanitary condition of the British army, and this in 1859 was extended to India. The European army was the special subject of it, but the native troops were referred to incidentally. Here the inquiry had to deal with a large body of men, concerning whom, their conditions of existence being well known, reliable information was accessible. It was ascertained that up to that time the annual death-rate over a long period had stood at 69 per 1,000. The inquiry resulted in certain changes and improvements in the housing, clothing, food, and occupation of the soldier. Since those have been carried out there has been a steady decline in the death-rate, and the annual reports of the sanitary commissioners to the government of India gave the rates as, in 1886, 15.18 per 1,000; 1887, 14.20; 1888, 14.84. During some years it has been even lower, down to 10 per 1,000, while the general efficiency of the troops has increased. As to native soldiers with whom the European troops may be compared, I find that the death-rate was, in 1886, 13.27 per 1,000; 1887, 11.68; 1888, 12.84. Famine, cholera, and other epidemic visitations. in some years disturb the regularity of the death-rate; under less favorable conditions of living, as in the case of prisoners in the jails, it is somewhat higher. In the Indian jails, for example, it was, in 1886, 31.85 per 1,000; 1887, 34.15; 1888, 35.57.

On the whole, all this indicates improvement, and as regards the civil population progress also is being made; but here, from so many disturbing causes, the figures are neither so easily obtained nor so reliable. The comparatively large mortality is due to neglect of the common sanitary laws, added to extremes of climate which favor the incidence and diffusion of epidemic disease, and intensify it when it has once appeared. A sanitary department has existed in India since 1866, and every effort is made by government, at no small cost, to give effect to sanitary laws. There can be little doubt that the results, so far, are good, that disease generally is diminishing, and that life is of longer duration.

An important result of the observations of the able medical officers of the sanitary service of India has been to show that cholera is to be prevented or diminished by sanitary proceedings alone, and that all coercive measures of quarantine or forcible isolation are futile and hurtful. Here I may say that, large as may appear the death-rate from cholera in India (i.e., in 1888, 1.99 per 1,000 for the European army, and 1.35 for the civil population), it is small compared with that of fevers, which caused in 1889, 4.48 per 1,000 in the European army and 17.09 in the civil population; but there is every reason to believe that these also are becoming less fatal under the influence of sanitary measures.

In preventive as in curative medicine, knowledge of causation is essential. It is obvious that any rational system of proceeding must have this for its basis. A certain empirical knowledge may be useful as a guide, but no real advance can be expected without the exactitude which results from careful scientific observation and induction; the spirit of experimental research, however, is now dominant, and progress is inevitable. How much we owe to it is already well known, whilst under its guidance the reproach of uncertainty which attaches to medicine as a science is disappearing. Recent advances in physiology, chemistry, histology, and pharmacology have done much to throw light on the nature and causes of, and also on the means of proventing or of dealing with, disease. It is impossible to exaggerate the value of the scientific researches which have led to antiseptic methods of preventing the morbific action of micro-organic life, whether the toxic effects produced by them, or those induced autogenetically in the individual. Theory has here been closely followed by its practical application in prevention and treatment of disease, whilst the study of bacteriology, which is of such remarkable pre-eminence at the present time, is opening out sources from which may flow results of incalculable importance in their bearing on life and health. That the conclusions arrived at are always to be depended on I doubt, and it seems that scientific zeal may perhaps sometimes outrun discretion. That it might be wiser to postpone generalization has, I think, been more than once apparent, whilst the expediency of further investigation before arriving at conclusions which may subsequently prove to be erroneous should not be lost sight of; but it has probably ever been so in the course of scientific progress, that in the enthusiasm of research, which is rewarded by such brilliant results, early generalization has too often been followed by disappointment, and it may be by temporary discouragement of hopes which seemed so promising.

It would be well to bear in mind a caution recently given by the Duke of Argyll, "that we should be awake to the retarding effect of a superstitious dependence on the authority of great men, and to the constant liability of even the greatest observers to found fallacious generalizations on a few selected facts" (*Nineteenth Century*, April, 1891). Still, it is in the region of scientific research by experiment that we look for real progress, and we can only deplore the mistaken sentiment, the false estimate, and the misconstruction of its aspirations and purposes, which have placed an embargo on experiment on living animals, rendering the pursuit of knowledge in this direction well-nigh impossible, if not criminal; whilst for any other purpose, whether of food, clothing, ornament, or sport, a thousandfold the pain may be inflicted without question. The inconsistency of the sentiment which finds unwarrantable suffering in an operation performed on a rabbit, when the object is to preserve human or animal life or prevent suffering, but which raises no objection to the same animal being slowly tortured to death in a trap, or hunted or worried by a dog, needs no comment; whilst the spirit which withholds from the man of science what it readily concedes to the hunter is, to say the least, as much to be regretted as it is to be deprecated.

It must be remembered that, important as are the researches into microbiology, there are other factors to reckon with before we can hope to gain a knowledge of the ultimate causation of disease. It is not by any one path, however closely or carefully it may be followed, that we shall arrive at a full comprehension of all that is concerned in its etiology and prevention, for there are many conditions, dynamical and material, around and within us which have to be considered in their mutual relations and bearings before we can hope to do so; still, I believe we may feel satisfied that the causes of disease are now being more thoroughly sought out than they ever have been,— all honor to those who are prosecuting the research so vigorously,— and that though individual predilection may seem sometimes to dwell too exclusively on specific objects, yet the tendency is to investigate everything that bears upon the subject, and to emphasize all that is implied in the aphorism, *Salus populi, suprema lex.*

NOTES AND NEWS.

AT the meeting of the committee on organization of the National Association of Government Geologists, Aug. 29, the secretary, Mr. Arthur Winslow, was instructed to draft a constitution and by-laws to be submitted to the committee at a meeting to be called in connection with the annual meeting of the Geological Society in December next. The secretary was further requested to notify all State geologists of this movement towards organization, and to invite them to be present at the next meeting.

— At the monthly meeting of the Field Naturalists' Club of Victoria, held on July 13 last, as we learn from *Nature*, Messrs. Luehman and French read a note and exhibited the skin of a tree-climbing kangaroo from northern Queensland, new to science, to which they gave the name of *Dendrolagus muelleri.* This remarkable marsupial has a body about two feet in length, with a tail somewhat exceeding two feet. The disproportion between the fore-legs and the hind-legs is not nearly so great as that of the ordinary kangaroo and wallaby; the toes are strong and curved, to enable it to climb tall and straight trees, on the leaves of which it exists. This tree-kangaroo is more nearly allied to the species which was discovered a few years ago in Queensland than to the two species from New Guinea. The specimen described was got from a straight tree, about ninety feet above the ground.

— M. Imfeld, the Swiss engineer, who has been engaged to examine the nature of the summit of Mont Blanc for the construction there of M. Janssen's proposed observatory, recounts in a Zürich journal the difficulties he is experiencing in his preliminary survey. *Nature* states that M. Imfeld is staying with eight workmen and two doctors at M. Vallot's observatory, which has an altitude of 4,400 metres, and thence they proceed daily to the summit, where they work for several hours a day in the endeavor to ascertain the depth of the snow for the purpose of getting the necessary foundation for the building. M. Eiffel has expressed the opinion that the construction of an observatory will only be possible if the snow does not exceed a depth of twelve metres. M. Imfeld states that they have encountered traces of a ridge of rock eighteen to twenty metres below the summit, and covered with about one metre of snow. They have therefore commenced to make a series of lateral tunnels on three sides, at a distance equal to twelve metres below the summit, to ascertain if the ridge extends to that height. Progress is necessarily slow. Most of the men are suffering from *mal de montagne.* Some, however, who are engaged at M. Valiot's cabin, are able to work almost as long as in the valley, and they also eat and sleep well. In spite of two coke stoves, the thermometer of the cabin never rises above zero; even ink freezes, and water boils at 83°, and they cannot properly cook meat. For a day or two they were disturbed by violent storms.

— In a bulletin recently published by the Pennsylvania Experiment Station (State College, Centre County), Professor William A. Buckhout gives some valuable information relative to the culture of the chestnut. The chestnut cannot be grown successfully on heavy clays, wet soils, or limestone land. It prefers loose, sandy soils, or such as has been derived from the decomposition of slates and shales. In Ohio it is found native on the sand ridges which border on the lake shore, and on the shaly hillsides of some of the hill counties in the southern portion of the State, but never on the limestones which cover the western and south-western portions of the State, nor can it be cultivated in this region with any prospect of success. The chestnut grows readily from the seed, but the greatest care must be exercised not to permit the nuts to become dry. To accomplish this they must be planted as soon as gathered, or else must be kept in moist sand until ready to plant. If possible the nuts should be planted where the tree is to stand, as the chestnut has a long tap-root which renders transplanting difficult. Our native chestnut is practically of but one variety; the European chestnut is not only much larger and finer than the American, but has produced, under cultivation, a number of varieties, some of which are highly esteemed for the superior quality of their fruit. The trees do not grow so large as the American, and come into bearing more quickly; the latter does not usually fruit until ten or twelve years old. Within the past few years species from Japan have been introduced into the United States. Unfortunately they do not appear to be entirely hardy, except in the South and some favored localities in the Middle States. They are quite dwarf in habit, produce nuts larger even than the European, and begin to fruit when they are but four or five years old. These two characters, small size and early fruitfulness, give them special value, and if they can be worked upon stocks of the American species we can secure trees which will bear earlier and produce larger nuts than our native species. The supply of chestnuts never equals the demand in this country, and many districts in which the trees are abundant derive a very respectable income from the sale of the nuts. It is therefore obvious that this is an industry which can be made far more productive and profitable than it now is, since very little effort has been made towards cultivation.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

THE FARMER AND TAXATION.[1]

[Continued from p. 132.]

IT has been proposed, indeed has been done in many States, to make every man swear to the truthfulness of the returns, and to provide adequate penalties for false returns. Experience shows, alas, that men will swear falsely by the wholesale and really seem to think little of it. Nor would any American community favor the establishment and enforcement of penalties which would really accomplish anything in this direction. As long, therefore, as this system remains we may expect to see the farmer unjustly burdened, simply because, as conditions are, a larger portion of his wealth is in such a form that it cannot escape taxation.

The country districts are, however, at a disadvantage in another direction. Owing to their declining wealth and population they must either continually advance the tax rate or they must be content to see the public institutions of the community go slowly backward. The number of people in the country as compared with the city is, as we have seen, steadily decreasing, i.e., the cities are growing steadily larger, and embracing a continually increasing proportion of the population. This means, of course, either that the burdens for the support of schools and other public institutions will grow heavier and heavier, or that they shall not advance, or, indeed, shall retrograde. It is no uncommon sight to see the schools gradually deteriorating in the rural districts. It is not merely true in Pennsylvania, Ohio, and Illinois, but even in the New England States,— that classic land of education, where all classes take a pride in the liberal support of all public institutions, such as the school, the church, the public library, etc.

This is a disadvantage not merely for the country but for the city as well. Once let the rural school and other similar institutions become thoroughly low in character, and more and more people will wish to leave the country, and the stream into the cities will be swollen still more. American people will not be content to live permanently in a region where all the institutions which make life worth living are gradually going backwards.

[1] Address before the Section of Economic Science and Statistics of the American Association for the Advancement of Science, at Washington, D.C., Aug. 19-25, 1891, by Edmund J. James, vice-president of the section.

It is for the interest of the whole nation, then, and not merely for that of the farmers, that the attractions of country life shall be increased and not diminished. The existence of good schools, churches, good roads, lyceums, libraries, and other means of education, throughout the country districts is necessary to the welfare of the whole community. Our great cities live upon the country in more senses than one. They are dependent upon it not merely for the material means of living, such as grain and meat, but for population itself. Statistics show that the death-rate in cities is rather higher than the birth-rate, i.e., if the cities could not draw upon the country they would soon begin to decline in size. Such being the case, it is of the highest importance to the cities, and to the country as a whole, that those classes which feed the cities, and give them the very bone and sinew of their existence, shall have the very best opportunities for an education. In the interest of the rural districts themselves the same thing is demanded. The draining away to the cities of the best blood of the young generation inflicts a continual loss upon the country. And yet if the attractions of country life on its intellectual side cannot be increased we may expect to find this loss a continually increasing one. At the very time, then, that farmers ought to be making increased expenditures for public purposes, we find their means of making such expenses curtailed.

The farmer, then, suffers under the changes incident to the continual advance of the country. He suffers from the growing depopulation of the country, and he suffers from the incidence of a system of taxation which did well enough a century ago but is now as antiquated as the plough or wagon of that time. What shall be done to help him?

In the first place, trying to doctor the present system here and there, as I said before, will not help him. We cannot materially improve our present system of taxation by little changes introduced here and there. I take absolutely no stock in the desirability of attemping it, or in the hope of achieving success if it were attempted. A general property tax, such as we have now in most of our American States, I regard as a hopelessly inefficient one, and highly unjust in all its effects. Even if it were possible to do anything with it, I should be opposed to retaining it, as it is, in my opinion, fundamentally vicious in such a condition of society as ours. It is, moreover, impossible to do anything with it, because it cannot be enforced. It is useless to try to ascertain all the property which a man possesses in our society. It was not possible for the tax gatherers in the Middle Ages to do it, when they could apply the thumb-screws *ad libitum* as an assistance to the memory of forgetful tax-payers,— how much less to day, when no jury in the United States would convict an ordinary citizen of perjury because of false returns to the tax assessor. When it is possible for a man like one of the Vanderbilts to swear that he has only $100,000 in the world which is liable to the general property tax, and it is impossible to prove the contrary in the case of such a well-known person, what is the use of trying to reach the property of the ordinary citizen by such means? I think I am fully within the truth when I say that no one who has made any study whatever of tax questions thinks that a general property tax upon personal property can be collected. The scientific students of taxation all agree, I think, to a man, that a general property tax of this sort is a relic of mediævalism, and should be abolished as soon as possible.

The farmers of all classes ought to be opposed to such a tax. Why? Because, besides the reasons already given, the effect is more injurious to the country than to the city.

It is easier to collect such a tax in the country, because people in the country know more, as a rule, about the affairs of their neighbors than those of the city. It would be impossible for a farmer to have any great amount of money invested in mortgages, etc., without it coming more or less to the knowledge of his neighbors, and hence to the ears of the assessor. In the city, on the contrary, the individual is lost in the crowd. The result is that as soon as the farmer has any considerable funds in this form there is great temptation to move to the city, and hence another inducement is added to the already too long list which tend to drain the country of its very best elements.

The taxing of mortgages and money at interest is another subject which has attracted a great deal of attention. Who pays this tax? Some authorities say the borrower, some say the lender. Of course, if a tax be levied upon money now invested in mortgages, and collected from the owner of the mortgage, the money-loaner must pay it. But how about the new mortgages? If it were possible to reach absolutely all the money up for loan we might make such a combination possible by which the loaner would have to pay it. But as things are now, the bulk of the money escaping it altogether, even in those States where such a tax is nominally levied, with many States which do not seriously try to levy such taxes, he must have large faith who believes that the money-lender must pay this tax instead of the farmer, when he charges so much the more interest by reason of the tax. At any rate, it is not an important element in this problem, in my opinion. We must begin at the other end and try to reach quite a different class in the community. We can dispense with the tax on mortgages very easily if we reorganize our revenue system as we ought.

The farmer can be helped, then, as I insisted at the beginning of my paper, only by a radical change in our revenue system — a change which will remove taxation from the place where wealth is not, and put it where it is. To do this we must use the State and National Governments. Speaking generally, his taxation must be lightened, and the income of local communities, particularly the rural districts, must be increased for public purposes. The lines along which this revolution must be made I shall briefly indicate. In the first place, farming property should be exempted from all taxation for State purposes. This has been done already in some of the States, in Delaware among the rest. In Pennsylvania, for example, the tax on real estate is solely for local purposes. The State does not levy any assessments upon real estate for State purposes. This may not seem a very considerable lightening of the burdens, but it is important, since when a man is loaded beyond his strength every decrease of the burden is of significance. In the second place, the State must come to the support of the local community, and that in two ways. It must distribute large sums to the communities for the support of local institutions, like the schools; and it must assume the entire expense of certain public functions, like that of justice, and especially the support of the unfortunate poor, such as the insane, the blind, idiotic, etc., as also the expense for penitentiaries.

The support of the unfortunate poor is something which no local community can reasonably undertake, for it has not the facilities to extend such care to them as our modern humanity demands. All such people ought to be put in asylums and supported at general and not local expense. Nor can the local units afford to provide as they ought for the criminal classes. They are, moreover, oftentimes not at all responsible for the criminal character of the population, as the latter may have drifted in from other communities, or, indeed, from other States.

The care of the unfortunate and criminal classes requires the employment of highly educated and specially trained people, whose services can not be commanded by localities, even if they could pay the expenses for suitable buildings, which, as a rule, they cannot. The expense of the courts might also be borne by the State to a very large extent. The existence of county courts, for example, does not accrue alone to the benefit of the people of the county, but quite as much to the people of other localities, or indeed of other States, who may have occasion for any reason to claim their services in any action at law.

The support of schools is also a function in which not merely the local community is interested, but all parts of the State as well. I think that every one must say that our farming communities are not at present able to pay the expenses of really good elementary schools. It is, in a large proportion of the rural districts, impossible to find anything more than elementary schools. Yet there is no reason why the advantage of good high schools should not be open to farmers' children as well as to the children of city people. If there were good schools in the country, we should find that many people would stay there who now go to town as soon as they can rake and scrape the money together. The only way in which such school facilities can be offered is for the State to come to their aid in an efficient manner. In many of the States already a school fund is provided, the proceeds of which are distributed among the school districts. In some States this pays the salary of the teacher for six months or more in the year. In other places the State government raises by taxation a large sum, which is distributed in the same way among the school districts. In a few States the State government pays a large share of the expense wherever communities will establish high schools. Adequate educational facilities can never be obtained in this country until the State governments undertake to look after the matter themselves, and contribute handsomely to the support of good schools of all grades. It is simply impossible for the farming districts, under existing conditions, to raise adequate sums for this and all other purposes which they must look after.

Another department in which the localities must be aided is that of maintaining good roads. Since the advent of the railroads we have done next to nothing toward improving our local means of communication. Such abominable, horse destroying highways as exist in most of our American States you can not find in any other civilized country. The farmers waste as much money, time, and horse flesh in getting their crops to market over a few miles of our ordinary American roads as would suffice to take the crops around the world on a railroad or steamer. Local management and support of the roads, as we try to work it in this country, has always given poor roads in every country where it has been tried. All other civilized countries have gone over to a reasonable system, under which the leading roads of the State are under the supervision of State engineers and at State expense; the roads which are merely county are kept up by the county, while only the very subordinate roads, the paths across the fields, etc., are saddled upon the road district. The roads are, however, to-day of immensely greater importance to the farmer than they were a century ago. In 1800 nearly all the products of the farm were consumed on the farm. To-day the bulk is shipped to market. The cost of transportation is largely a burden on the farmer. Any diminution in the cost helps him, and it also helps the inhabitant of the city; and while the latter profits by good country roads he contributes nothing to their support, but leaves the entire burden of constructing and maintaining them on the farmers.

Local management of these institutions, then, and the attempt to make the localities pay for them, lead to two things, relative overburdening of the farmers, and inefficient institutions. The general neglect of our country roads leads to the massing of the population along the railroads, placing them still more completely at the mercy of the railroad managers than they are now.

The thoroughgoing reform of our financial system means, however, more than the mere utilization of the State government in lifting the weight of local burdens. It means a further utilization of the Federal Government for the same purpose. Under the political system which we adopted a century ago we distributed the functions of that time among the national, State, and local governments in a way which experience has shown to have worked very well down to a recent date. If the economic conditions of a century ago had remained the same until to-day, the system would be still as good as then. But the railroad came in to modify and change everything. Aided by the federal, State, and local governments to the extent, in many cases, of building their lines for them, they have continued to increase in number and importance until they dominate our whole industry and government. Nothing can be done without their consent. No problem can be solved without considering the railroads. They have changed the centres of trade and industry. They have shifted the centre of agriculture. They determine more and more the lines along which industry and population must move. They have been built and are now building, not necessarily in places where the true interests of the country would have dictated, but oftentimes where ideas of private interest, caprice, and fancy may have ordered. They have built up great sections of the country, it is true, but they have also ruined others. They have developed farmers on the icy plains of Dakota and on the burning sands of New Mexico, but have driven a race of farmers to the wall in New England, Pennsylvania, Delaware, etc. I do not mean to say this is not good. It may lie in the interests of the country to change the centers of industry. But when this is done by a national policy it is not fair to ask one class to bear all the burden.

Now we have given to the nation the most fruitful sources of revenue and to the community the heaviest burdens to bear. The defence of the country against foreign aggression has never been a very heavy burden, and it is destined to become lighter and lighter; but the burden of keeping up the educational institutions of the country, the load of keeping up the means of local communication by the system of country roads, the support of the courts open to all citizens of the United States, the support of the poor, the blind, idiotic, insane, etc., are heavy, and continually growing heavier. To the federal government we have given the right to resort to all sorts of taxation,— duties on imports, on domestic products, on incomes, on lands, on polls, in fact every kind of privilege in this respect consistent with the practices of a free government, except taxes on exports. To the States we have, it is true, also given the right to levy all sorts of taxes except duties on imports and exports; but the industrial circumstances prevent us from resorting to the most fruitful sources, to those places where the real wealth of the community to-day lies. No State dares tax its domestic manufactures, for example, from fear that the manufacturers will move into another State. We cannot levy an income tax, for fear that the citizens will reside somewhere else. This practically keeps us from resorting to the most fruitful sources of revenue altogether. One may say, How is this different from the condition of things a century ago? If our fathers got along well then, why should not we now?

A century ago a State could resort to such taxes as it chose, because the impediments to changing one's residence or moving one's business were practically so great that nothing short of the very heaviest taxation could move one to try to avoid it by altering his location. To-day, on the contrary, thanks to the railway, there is almost no obstacle to living in one State and doing business in another. The merchant in New York city can live in Connecticut, New Jersey, or New York, or even Pennsylvania or Massachusetts, and still be in New York every day for business. The citizen of Wilmington can reside in Delaware, Maryland, Pennsylvania, or New Jersey. Of course under such conditions the various States have to be very careful about levying taxes, and the possibility of adopting taxes which a century ago were easy to use and collect is very much limited.

In a word, our financial system and our industrial system are no longer in harmony, and they are daily growing wider and wider apart. The bodies which have heavy public burdens have only limited financial resources, and those which have large resources have comparatively few functions. The places where the wealth is not are taxed, and those where it is are left untaxed. Now there are only three ways out of the difficulty. Either the functions of the federal government must be increased to correspond with the greater financial power of that body, or greater financial power must be conferred upon the local bodies by allowing them to tax imports from other States in order to enable them to adopt an excise system, or we must collect through the federal government those revenues for local purposes which can be reached only through its agency. The first of these is undesirable, the second impossible, while the third is at once practicable and possible.

If we would have a reasonable system of taxation we must entrust to each public body the collection of such taxes as it can most easily raise. Thus the tax on land can easily be raised by the local bodies, such as city, school district, township, and county. The taxes on corporations which do business over a whole State, like the railroad corporations, cannot be collected by the local communities. Nothing is more ridiculous than for a township, for example, to try to collect a tax on a railroad which runs through it. If it assesses merely the value of the road-bed for what may be termed ordinary uses, the assessment is, of course, ridiculously low. If the local assessors attempt to assess such a part of the whole value of the road as the local part bears to the whole length of the line, they have no means of compelling payment or of proving that their assessment is a fair or just one. The only sensible thing is to allow the State government to tax the railroads and divide the results of the tax among the communities in the State. The same thing is true of other sorts of taxes as well.

In the same way the collection of import duties is one of the most fruitful sources of taxation, and that whether you take a so-called tariff for revenue only, or a so-called protective tariff. No State or local community can collect these taxes, and yet to let these taxes go uncollected would be a very short-sighted financial policy, since you can raise large sums by this device without injuring the country at all.

Take, again, the whole line of manufacturing trusts and similar organizations in this country, the Standard Oil monopoly, for example. Here is an excellent subject for national taxation. No State can reach it. It has practically withdrawn itself from State control, and as we make no attempt to control it by national means, it is practically untaxed. Now this is very foolish and unreasonable. What shall be done about it? No city or county or State can tax it Shall we let it continue to go untaxed? By no means. We should tax it through the agency of the national government, and take the proceeds for local purposes.

We must no longer look upon the county government as opposed to the township in matters of taxation, or the State to the county, or the federal government to the State, but upon all as a part of one and the same system of government, to be used by the people in the manner and to the extent to which its interest may dictate.

In a word, then, the solution of the financial difficulty in this country, as I look at it, is simply this: Let us use each part of the government, city, town, school district, county, State, and nation, to administer those taxes which it can most easily manage, and then divide the proceeds upon such basis as experience may dictate to be the best. Briefly indicated, and only in the most general way, the land tax ought to be left to the ultimate unit — city, town, road, school, poor district, etc. The State ought to levy an elaborate system of corporation taxes upon such corporations as it can efficiently reach; and, finally, the nation ought to levy the indirect taxes, such as excise and customs duties, and such other taxes as circumstances may show to be desirable, such as taxes upon the great combinations of capital which extend their operations over the whole country, and possibly also upon incomes. We should take the proceeds of such taxes beyond what may be necessary for an economical administration of federal affairs, and utilize them for local purposes. The States should use the funds derived from the taxes administered by itself, partly for the performance of a larger range of functions, partly in assisting in the performance of local functions, as in making roads, etc., and partly in distribution among local units for local purposes, as schools, etc.

I am all the surer that this is the proper solution, as it is the one which modern nations situated somewhat like our own have found it necessary to adopt. As said above, the problems of modern taxation have come up in all nations in a very similar form. Local taxation has assumed an importance hitherto unknown, and the relation of the farming class to other classes in this matter has been a troublesome one. England, France, and Germany, which in their economic conditions most resemble our own country, have all found it necessary to resort to some such plan as that here outlined.

No amount of patching is going to help us in this matter. No attempt to strengthen the hands of local tax assessors or tax collectors is going to afford any permanent relief. The more tax commissions we have which give such advice as the late ones have given us, the more money will be wasted, and the time will be the more delayed when a reasonable system will take the place of the present antiquated patch-work.

Before closing, I should like to revert again to a point already mentioned, touch upon another phase of the question which I regard as even more fundamental than that of taxation, important as is the latter, and that is, the whole economical condition of the farmer as compared with the other classes in the community. I touched, at the beginning of my address, upon the revolution which the modern system of transportation had effected in the condition of the farmer; how it has brought into competition with him not only the farmer of the Mississippi Valley, but has planted a competitor on the slopes of the Pacific, nay, even opened up Africa and Australia as competing territories. The farmer was formerly assured of a certain even though it were a small market. His market is now large but very uncertain.

The farmer feels the burden of taxation, in a word, largely because his economic situation has become an unfavorable one. The prices of agricultural products of the staple variety have gone down in the great European market upon which we rely to dispose of our surplus products. It looks very much as if they would never rise again, at least not for a long time to come. The settlement of Australia, of South America, and of Africa will more than keep pace with the wants of the world for breadstuffs; and until Russia, Asia, India, Africa, Australia, and South America are so fully settled that they will consume their own food-crops we need not expect to see a rise in the price of staples. No amount of bait thrown out to European nations in the form of low tariffs is going to persuade them to take our corn and wheat at high prices when they can get Russian and Indian products at low prices.

Now if this be a true diagnosis of present conditions, what can the farmer do to be saved from being ground to powder between the upper and nether millstones; between a system of taxation, on the one hand, which leaves the great accumulations of wealth relatively untouched, and rests chiefly on agriculture, and a world-economic movement, on the other, which is knocking the bottom out of all staple products? My answer to this question, as far as the first point is concerned, is to reform your system of taxation; as to the second, make yourselves independent of the staples. Let us try to discover and utilize new products. We can no longer rely upon the old crops to keep us alive. We must discover new branches of agriculture. Perhaps it will be found, as in Germany, in the discovery of a sugar plant, or in the cultivation of tea or coffee, or a new textile plant, or something else. Now from what source have we to look for the introduction of such a plant or plants? Who can bear the initial expense of ascertaining by a long series of costly experiments what kind of soil and climate are best fitted to each new crop. Manifestly only the government. Hence the absolute necessity of the government experiment station, planted in every State, and endowed on such a scale as will enable it to make the most costly and long-continued experiments upon every new crop which seems to promise any hope of naturalization. We have been naturalizing men long enough. Let us now try systematic plans to naturalize every useful plant which is to be found in any other country. The federal government has begun this work on a fairly liberal scale. It should be your business as farmers to see that these appropriations shall be made on a still larger scale than ever, and that in each district in the State a careful examination of soil and climate by scientific experts shall be made, with a view of determining what new crops can be introduced into such places. In this way you will find that the introduction of a new crop will go a long way toward solving the taxation and all other problems, since it will introduce prosperity where adversity now prevails — an expanding agriculture instead of a declining one, etc.

Perhaps a word might not be out of place at this point as to the work of the experiment stations themselves. I cannot help feeling that much of their effort has not been so economically applied as it might be. It is, of course, an interesting fact to know what the growing power of a pumpkin is, for example. How many tons a water-melon vine can lift in the course of a year, and similar items of information, may, in the course of time, when all added together, produce valuable practical results; but I cannot but believe that a much larger share of the time and effort should be devoted to ascertaining the possible uses of the thousand-and-one forms of vegetable life around us. Man progresses but slowly. Of the thousands of plants which cover the face of the earth we have found use for comparatively few. They are mostly still ranked in the category of weeds, i.e., useless or injurious plants. It has not been so very long since the potato was in this category. Now it is my opinion that every plant has some valuable use or other if we only knew it. It is pre-eminently the work of such scientific stations to enlarge the number of useful plants by such experimentation as shall test their applicability to one or another of the practical arts. He who makes two blades of grass to grow where only one grew before is a benefactor of the race. How much more a benefactor he who gives two useful plants instead of one. Who can calculate the advantage to humanity of the development of the potato or of the sugar beet?

The scientific experimental station, then, should give us new plants, naturalize those already known, and determine the best conditions for the cultivation of all kinds which may be made to grow in any given locality. The same thing should be done, of course, for animals as for vegetables. There is little doubt that in each State, for example, many plants and animals could be profitably cultivated which are practically unknown at present. The experimental stations should work at these problems until they are successfully solved. I say at each station, for the station of Pennsylvania, or that of Illinois, or Ohio, will benefit Alabama only indirectly, since crops which will grow very well in the former States will not grow well in the latter, and many which might prove profitable in the latter would not grow in those States at all. Each locality must solve its own problems in this respect for itself. It has been found, for example, even in such a small country as Germany, that a beet which will produce a large quantity of sugar in one part of the country, when taken to another loses its sugar very quickly. How much more would that be the case in such a country as our own.

Let us keep up our experiment stations then. Watch them closely, to see that they are at work at useful things, but support them liberally. See to it that the federal government, which has now begun the support of these institutions, shall deal liberally with them. Give them all the money they can wisely use. We shall find that that will be a great deal, and you will find that it will very well pay for itself.

HEALTH MATTERS.

The Tetaniferous Man.

Verneuil applies this term to the individual who carries the virus of tetanus around on his person, although unaffected by the disease himself. The author discusses the causes and means of prevention of this affection from a clinical standpoint. If one considers the horse, with its secretions, excretions, and surroundings, as all-capable of propagating tetanus, we cannot regard as impossible infection by the secretions and excretions of man. The tetanic property of equine saliva has been demonstrated. The saliva of a human being may, for the time being, contain tetanus germs, and thus a bite from such an individual may cause tetanus. A case is given illustrating this. The secretions and excretions are only infected by the ingesta, so that the sperm, milk, and urine are never infected by the virus. He says, according to the *University Medical Magazine:* "I have already admitted, and now I admit more than ever, that a surgeon who has dressed a tetanoid patient may communicate the disease to other patients. I also admit that any person whatever, but above all a physician whose hands have been in contact with a horse, not tetanic, but simply tetaniferous, may infect the wounds of his fellow-beings, as in the cases cited. I also admit, finally, that such a man is not only dangerous to those whom he approaches, but may even give himself tetanus by auto-inoculation, either by wounding a part of the skin impregnated with the virus, as the plantar and palmar regions, or touching a wound on any part of his body with his impure hands." Two cases follow, in which he traces the cause to a wound inflicted on the skin, which was previously infected with the tetanic virus. The bacillus of Nicolaier was found in one of these cases. Three additional cases are given with a very careful analytical study of each.

London's Soot.

The amount of carbonaceous and other particles deposited upon glass houses is a good indication of what the London atmosphere contains, and in many places it is only possible to procure a due admission of light to the plants by frequently washing the glass roofs. At one establishment, says the *Pharmaceutical Record*, two tanks constructed to collect the rain from a house completed a few years since, were cleared out, and no less than ten barrowloads of sooty matter were removed, all of which must have been conveyed into the tanks from the glass. One scientific man has been engaged in computing the amount of soot deposited from London air, and arrived at the following conclusions. He collected the smoke deposited on a patch of snow in Canonbury one square link (about 8 inches) in extent, and obtained from it two grains of soot. As London covers 110 square miles, this would give us for the whole area 1,000 tons. As the quantity measured fell in 10 days, a month's allowance would need 1,000 horses to cart it off, and these stretched in a line would extend four miles.

Origin and Role of Pus Cells.

Professor Ranvier made an interesting communication at a recent meeting of the Academy of Sciences on the origin and signification of pus cells. He said (Brit. Med. Jour.) that for some years past histologists generally were agreed that the cells of pus were none other than the white corpuscles of the blood, which had emigrated from the vessels at the time suppuration was set up. He found it difficult, however, to believe that the blood could yield in this way, and in a time comparatively short, the enormous quantity of pus found in many pathological conditions, such, for example, as the purulent infection of wounds, accidental and operative. That the white cells do emigrate in the manner generally accepted he had no doubt. This takes place under normal physiological conditions, while it is still more pronounced in certain pathological states not ending in actual inflammation, in the process of which it is, of course, abundantly evident. What his experiments led him to establish, however, was that pus cells had also quite another origin, viz., the transformation into lymph cells of clasmatocytes, elements derived from migratory cells, which under the influence of irritation revert to an embryonic condition and proliferate rapidly. As to the *rôle* of the pus cells, M. Metchnikoff has shown the importance of lymphatic cells in the combat of the organism against microbes. In simple inflammation determined by caustics, or other irritant agents, their *rôle* is not less important. They eliminate the dead elements, and thus prepare the way for the processes of regeneration.

The Value of the Tongue as a Respirator.

J. M. Elborough writes as follows to the *Lancet:* It is not generally known that nature has provided each of us with the best respirator always at hand in the tongue. For years I have personally relied on this alone, and have recommended this proceeding to many patients. When facing a cold east wind, or breathing quickly the night air, I never quite close my mouth, but purposely keep the lips a trifle parted, and at the same time curl up my tongue towards the roof of my mouth until the tip reaches as far back as the soft palate, and I gently press the arched under surface of the tongue in some degree against the hard palate (a little practice soon makes this easy to do). The cold air then, as it enters the mouth, strikes against the under surface of the tongue, as well as the floor and sides of the mouth, and is made to pass in a somewhat circuitous manner between the sides of the tongue and the buccal mucus membrane of the pharynx, being thereby warmed in its course, so that by the time it reaches the larynx it is nicely rid of chill, and does not excite cough and catarrh. At the same time a certain quantity of air, of course, finds its way through the nasal passages to the chest, and it is obvious that a larger quantity of cold air can be effectually warmed by this method of procedure than by relying on either the nose or mouth alone. That the large blood-supply of the tongue renders this organ an excellent air warmer must be obvious to all.

The Sense of Taste in the Larynx.

For many years it has been known to histologists that the specific end-organs of taste, namely, the taste-bulbs, occur on the posterior or inner surface of the epiglottis, but up till now the physiological proof of the existence of the sense of taste in the epiglottis has not been forthcoming. Michelson, according to the *British Medical Journal*, Aug. 8, under Langendorff's direction, made a number of experiments, which show that the inner surface of the epiglottis is endowed with taste. A Schroetter's laryngeal sound, tipped with a solution of quinine or saccharine, was introduced into the larynx, and the drop of the sapid substance was cautiously brought into contact with the inner surface of the epiglottis. Positive results were obtained, which were controlled by the sensation — electrical taste — known to be produced by electrical stimulation. It seems, therefore, proved that a part of the nerve fibres passing to the larynx are nerves of taste.

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.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

An Upright-Walking Lizard.

I REMEMBER reading, some time ago, a report of the discovery of the fossil remains of a large lizard-like creature which must have walked upright on its hinder limbs. The saurians which made the footprints found in some sandstone formations probably walked in the same manner. But it may not be generally known that at least one existing species of lizard habitually runs erect on its hind-legs. This little fellow I noticed, in May, 1891, on the Mojave Desert of California, between Mojave and Death Valley. He is about one foot in length, of color varying from pale yellow to orange. His forward limbs are short and slender. While feeding, he holds his food in his fore-paws, much as a squirrel holds a nut. While seeking food, or resting, he remains on "all fours," but on starting off, especially if frightened, he rises on his hinder legs and runs away very swiftly, the action of the legs having a ridiculous resemblance to those of a small boy "in a hurry." I have seen one of these lizards run in this manner for thirty or forty yards. C. W. KEMPTON.

New York, Sept. 8.

The Application of Concussion to Suspended Mist.

PROFESSOR H. A. HAZEN'S recent criticism of the rain-making experiments seems well-timed. As Espy made important additions to the theory of latent heat as applied to the uprising moist air in cyclones, would it not be well to try the experiment of successive concussions upon suspended mists. If very small drops of rain collect upon a window pane any sudden jar will cause the small drops to coalesce into large drops. Then why is it not possible to produce a like effect upon small floating rain particles? The concussion from a lightning flash usually results in an immediate downpour. By all means let those who have experimented come forward with the results. WILLIAM A. EDDY.

Bergen Point, N.J., Sept. 5.

AMONG THE PUBLISHERS.

THE S. Carson Company, San Francisco, have just published "Forensic Eloquence," by John Goss, a treatise on the theory and practice of oratory as exemplified in great speeches of famous orators.

— D. C. Heath & Co., Boston, have issued "A Brief Spanish Grammar," by Professor Edgren of the University of Nebraska.

— Professor W. S. Chaplin, professor of engineering at Harvard University since 1880, has been elected chancellor of Washington University of St. Louis.

— The Tragedy of the Cæsars" is the title of a new work by the Rev. S. Baring Gould that Methuen & Co. have in the press and hope to issue shortly. It will be illustrated from busts, gems, cameos, etc.

— Houghton, Mifflin, & Co. will publish on the 12th the first two volumes of the new large-paper edition of the works of Oliver Wendell Holmes; and a new cheaper edition of S. P. Langley's "The New Astronomy."

— Major Wissmann's new book of African travel from the Kongo to the Zambesi, in the years 1886 and 1887, which he calls "My Second Journey Through Equatorial Africa," will be published in England by Chatto & Windus. The volume will contain a map and nearly a hundred illustrations.

— Messrs. Macmillan & Co. intend to publish soon a series of popular sketches on the history of astronomy from the earliest times to the present day, in the form of a volume containing three courses of lectures on astronomical biography by Professor Oliver Lodge, F.R.S. The work will be fully illustrated, and will bear the title "Pioneers of Science."

— The assiduous biographer of Dr. Johnson, James Boswell, would certainly approve of the devotion of his own biographer, Mr. Percy Fitzgerald, who has written a "Life of James Boswell," which is to be published shortly by D. Appleton & Co. Mr. Fitzgerald has made a book full of anecdotes. It will contain portraits of Boswell and of Dr. Johnson.

— Charles Scribner's Sons have in preparation a series of concise biographies of the men whose systems have marked successive stages in the progress of education, from Aristotle to Dr. Arnold. It will be edited by Professor Nicholas Murray Butler of Columbia College. Mr. Thomas Davidson will undertake Aristotle; J. G. Fitch, Pestalozzi; J. Courthope Bowen, Froebel; Professor Butler, Horace Mann.

— The recently completed fifth edition of Dr. M. Foster's well known "Text-Book of Physiology" will be followed at once by the appearance of a sixth and cheaper edition of the work in parts, carefully revised throughout by the author. The addition of much new matter to this edition of the book will permit of taking out a copyright on the American edition, which is to be published by Macmillan & Co.

— Roberts Brothers will publish soon a new volume in Miss Wormeley's series of translations from Balzac's works, entitled "An Historical Mystery," being one of the "Scenes from Political Life;" a complete edition of Burnand's "Happy Thoughts," and the first American edition of the same author's "More Happy Thoughts;" the third volume of Renan's "History of the People of Israel," treating the subject from the time of Hezekiah till the return from Babylon; and "Four and Five," by Edward Everett Hale, which is a continuation of the "Ten Times One" series.

— The aim of "The Transition-Curve Field-Book," by Conway R. Howard, C.E. (New York, Wiley), is to furnish plain, practical rules and examples for guidance in adjusting and locating a curve, nearly identical with the cubic parabola, as a transition-curve in connecting circular railway curves with tangents. The work is simplified in application by the aid of a general table, and illustrated by rules and examples for various problems of location. The book also contains tables of radii, sines, tangents, versines, and external secants (109 p. 16°).

— Silver, Burdett, & Co. have now ready "The Teacher's Handbook of Slöjd as Practised and Taught at Nääs," by Otto Salomon, assisted by Carl Nordendahl and Alfred Johansson, and translated and adapted for English teachers by Mary R. Walker and William Nelson. The volume belongs to the new department of wood-handicraft or educational carpentry, already finding a place in our advancing school system, and is an able exposition of the work done by the famous school at Nääs, Sweden. It contains explanations and details of each exercise and is generously illustrated.

— "Heredity, Health, and Personal Beauty" is the title of a book published recently by F. A. Davis, Philadelphia. The author is John V. Shoemaker, M.D., who is a professor at the Medico-Chirurgical College of Philadelphia. There seems to be some confusion in the matter brought between the covers of this book; for, while the main portions are devoted to the laws of health as understood by the author, there is introduced considerable matter that has a bearing primarily on the doctrine of evolution, and not directly, at least, on the preservation of health. The author is an advocate of all things moderate in this life. The mode of treatment of the subject is such that the non-professional reader can readily follow. Not only are there given suggestions as to the mode of life most likely to lead to general good health, and consequent good looks, but the methods considered best for the care of the skin, nails, and hair are discussed in several long chapters.

— The Johns Hopkins Press are preparing a volume on the "Spanish Institutions in the South-west," by Frank W. Blackmar, professor of history and sociology in the Kansas State University, which will be ready shortly. The work is a study of the social and political institutions of Spain as represented by the life of the Spanish colonists in America, consequently it treats of the founding of the Spanish missions in California, Arizona, New Mexico, and Texas, and portrays the civilization established by the padres, the social condition of the Indians, and the political and social life of the pioneers of the South-west.

— Hon. Carroll D. Wright will begin in the October *Popular Science Monthly* a series of papers under the title "Lessons from the Census." In the first of these he sketches the changes in scope and methods which the United States census has undergone in the past hundred years, and shows that its immense growth has made it a somewhat clumsy machine. The series of articles on American industries will be continued in the same number with a fully illustrated account of "The Manufacture of Steel," by William F. Durfee, giving the history of the industry from colonial times to the introduction of the Bessemer process. Professor A. E. Dolbear will contribute an essay on "Metamorphoses in Education." It is a thoughtful paper, and shows that, since education is a process of fitting men for their environment, a change in its character was necessitated by the change in the conditions of human life that has taken place in modern times. "The Rivalry of the Higher Senses" is the title of a paper by Professor G. T. W. Patrick. It points out how greatly we differ from the ancients in receiving most of our information through the eye while they took in theirs more largely through the ear. Some of the consequences of this change are also noted. The second of Professor Frederick Starr's articles on "Dress and Adornment" will be published in the same number. The author maintains that dress arose from a desire for ornament rather than from a sense of shame. He describes a number of beautiful garments that are made by savages, and illustrates his descriptions with a large number of pictures.

— Noonday Rock is a pinnacle projecting from the bed of the Pacific off the coast of California. It lies three miles to the westward of North Farallon Island, and is directly in the path of vessels bound to or from the harbor of San Francisco. In order to warn vessels of their proximity to this hidden danger, the lighthouse establisment keeps a bell buoy over the rock. Sometimes the buoy breaks adrift. There is then great difficulty in finding the rock on account of its small area and great distance from shore. In order to locate it exactly advantage is taken of its being a great feeding place for seals. When the light-house tender is near the spot the steam whistle is blown. The seals rise perpendicularly to the surface of the water, sticking their heads high into the air to find out what the extraordinary noise means. With the surf-boat already lowered, a trial can-buoy can be thrown almost exactly on the rock, thus saving hours of tiresome search.

SCIENCE

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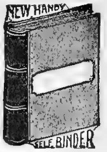

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SCIENCE

NEW YORK, SEPTEMBER 18, 1891.

THE AMERICAN MUSEUM OF ARCHÆOLOGY.

One evening early in November, 1889, a company of gentlemen gathered in one of the rooms of the Philadelphia Club, where an elegant dinner was spread. At the head of the table sat Dr. William Pepper, provost of the University of Pennsylvania, and on his right Dr. C. C. Abbot. F. C. Macauley, Esq., sat at the foot of the table, and along the sides were men so distinguished for scientific attainments and public spirit as Professor Edward Cope, Dr. Daniel G. Brinton, Dr. Horace Jayne, the late Dr. Joseph Leidy, and two or three others, — nearly all of them officially connected with the University of Pennsylvania. This institution is not heard of so often in New York and New England as are Columbia, Harvard, and Yale, with all of which, nevertheless, it stands abreast in most particulars. Its library, for example, is one-third larger than that at Harvard.

Up to the date of this merry little feast, which is recalled on account of its results, the University of Pennsylvania had lacked anything to compare with such museums as exist at New Haven and Cambridge, and which not only offer local students of the sciences great facilities, but become centres of original research and asylums for the preservation of valuable material. Thus far in the revival of enthusiasm, which during the past few years has been stirring the alumni and friends of the university, this feature had been neglected; but after the edibles and a part of the potables above-mentioned had disappeared, it was disclosed that these gentlemen had met and dined merely as a pleasant prelude to the discussion of the ways and means of organizing an archæological department and collection in connection with their university.

Dr. Leidy took the chair, the group (excepting Dr. Abbott, to whom these proceedings were all a surprise) resolved itself into a "commission," and in fifteen minutes, promptly and picturesquely, The American Museum of Archæology was in existence.

In the course of the discussion Dr. Abbott was introduced by Dr. Pepper in a speech which reminded his hearers, that, though Dr. Abbott composed books, and had even perpetrated a sonnet now and then, it was not as a poet he was ambitious to shine; that in spite of the fact that he had written the most charming and suggestive books of out-door lore published in America, this work and the attached credit were not foremost in the author's thoughts. Dr. Abbott's chief interest had been from the first in the investigation of the habits, conditions, social advancement, and mental attitude of the American aborigines; and to him science was indebted for valuable contributions in the direction both of materials and of philosophy; while the light which Dr. Abbott had been able to throw upon the antiquity of man in the eastern part of this continent, by his discovery of the stone implements and other traces of paleolithic man in the glacial-drift gravels of the Delaware Valley, had established beyond any reasonable doubt that practically primitive men had dwelt on these shores during, and prior to, the great glaciation of the northern half of the continent. He asked Dr. Abbott to say what disposition had been made of the great quantities of relics of prehistoric man which he had gathered, and whether the field was exhausted.

Dr. Abbott replied in a speech of some length. He said that his farm near Trenton, N.J., occupied a knoll overlooking wide meadows along the Delaware, which traditionally and evidently had been a favorite resort for the Delaware Indians and for their predecessors. From the ploughed fields and river-banks of this immediate neighborhood he had gathered some 30,000 relics, in stone, bone, and clay, of the aborigines, who had hunted, fished, camped, and manufactured their implements and utensils there. The earlier part of this collection had gone mainly to the Academy of Science at Salem, Mass., and to prominent European archæologists, but since the founding of the Peabody Museum of American Archæology and Ethnology at Cambridge, Mass., everything had been deposited there, where it constitutes the Abbott Collection, embracing 27,000 pieces. This includes the series of paleolithic (drift-gravel) implements and bones. The literary outcome had been many pamphlets and articles, and the book "Primitive Industry," which had summarized the results up to 1881. A new edition of this book is now under way, wherein later investigations will be noted.

The audience was surprised at the magnitude of what one man, with greatly limited means, had been able to accomplish, and regretted that this extremely interesting and valuable material had been taken to a distant museum out of territory which by right was local and belonged to Philadelphia, simply because that city had been too apathetic to obtain and preserve it.

Responding to a further request for advice, Dr. Abbott explained that systematic searching would bring to light a vast quantity more of the same kind of relics in the Delaware Valley, and probably largely extend our present knowledge of the prehistoric inhabitants of that region. He said that large areas of the United States were still unexplored archæologically; that there was abundant room for another organization without duplicating the labors of existing investigators; and that it was of the highest importance that such work should be done at once.

The result was the formation of an Archæological Association under the auspices of the university, the assignment of quarters for the storage and arrangement of materials, and the appointment of Dr. Abbott as curator. Subscriptions were immediately forthcoming for the present needs of the department, and a vigorous and organized effort is beginning for the accumulation of specimens and information, not only, but for the financial endowment necessary to the maintenance of the museum and the attendant instruction and publication of results. Dr. Abbott has consequently severed his official connection with the trustees of the Peabody Museum (who cordially wished him good-speed) and is devoting his energy to the work in this new field. About 25,000 specimens have already been received, and many more are promised as gifts, while the purchase of some small but valuable collections is under way. It is the policy of the managers, however, to conduct original and intelligent explorations, rather than merely to accumulate a large quantity of "Indian relics" by purchase, and arrangements are now making for the placing of several men in the field who are experts in this kind of scientific work.

Meanwhile the valley of the Delaware is being carefully attended to, and has yielded largely, much material having been collected that throws additional light on the customs and conditions of the Indians that for so many centuries occupied this region. During the summer of 1891 a large number of village sites were exhaustively explored, and two interesting rock shelters examined; while on an island in the river was found an implement maker's work-shop, and a "cache" where 116 beautifully chipped knives, averaging about six inches in length, was brought to light. The flint (jasper) quarry from which the Indians derived their raw material for arrow-heads, knives, scrapers, and drills was also located; the shaft they had sunk examined, and a vast quantity of cores, chips, unfinished implements, and hammers, mauls, and other implement-making tools, were procured.

Recently, through the generosity of several gentlemen, the superb Cope collection was secured, so that even now the museum has excellent facilities for illustrating the conditions of human life on this continent prior to European contact.

The first annual report, a pamphlet with beautiful illustrations, has already appeared, and, better than all else, shows how rapid has been the progress of the venture.

Altogether it appears probable that an institution has been founded which will become not only a source of great local pride and influence in Philadelphia, but will powerfully advance the cause of this most interesting of sciences throughout America. The need of money is great, and the rich men of the country, especially those who are alumni of the University of Pennsylvania, or interested in this part of the country, can find here a use for a portion of their wealth which will be most fruitful in the advancement of knowledge. It is to be hoped, too, that many persons in the Southern and Middle States, who have formed small local collections of archæological specimens, will see the wisdom of depositing them in this general museum, where they can do far more general good than hidden in isolated houses scattered about the country. May every success attend this new museum, and long live Dr. Abbott, its curator.

ERNEST INGERSOLL.

INFLUENCE OF GROUND WATER UPON HEALTH.[1]

THE examination of the historic records or of the published mortality tables of this and other countries shows that there are certain conditions which are found to be present when certain diseases are most rife. It is also found, that, after eliminating certain meteorological and other influences which are supposed to affect disease, some particular diseases appear to be solely influenced by the hygrometric condition of the ground and the volume of water which is present in the ground.

In historic periods when particular epidemics have been rife, they have mostly occurred in times of drought, in which it has been established, beyond doubt, by the evidence of the failure of springs and rivers, that the ground water was then exceptionally low.

The actual measurements of the ground water in this country, in some cases, go back for a period beyond that of the registration of deaths, consequently a comparison can be made between the state of the ground water and the death-rate of any particular period; and when such examination is made it is found that there is a coincidence between the state of the ground water and the deaths recorded. The deaths follow, as a rule, in the inverse ratio, the state of the lowest ground water; that is, high low water indicates a healthy period, while low low water marks the unhealthy periods. Investigations respecting the influence of ground water upon health should be studied over limited areas, as the distribution of rain is often very local, and there are varieties in the geological character of the soil that affect the result of observations carried on over large areas, and on this account, while observations have been carried on by the author over an extended area, he has always used local observations to compare with the mortality returns in the same district, and he has specially dealt with the records of Croydon, which is the place where the observations as to percolation, evaporation, and the hygrometric condition of the soil have been locally studied.

There is every reason to believe that the ground water itself, except when polluted, exercises no influence as a cause of disease, but is merely the measure or indicator of the influences which are at work within a polluted soil, and of certain organic changes which evidently take place within the dark recesses of the soil, and which lead to the development of the conditions favorable to a certain class of disease. That the earth does exercise a baneful effect upon health is well known from the experience in this country of the unhealthfulness of cellar dwellings, and from the fact that persons habitually living upon ground floors are not so healthy as those living in the upper stories of buildings removed from the influence of the ground.

There is a seasonable fluctuation in the waters in the ground, and, as a rule, these waters are lowest in the autumn and early winter, and highest in the spring or early summer; but in some years the period of both low and high water varies, as, for example, the low water of last season did not take place until February of this year (1891).

It is also known that the artificial lowering of the sub-soil waters of a district has produced the same effects upon the health as occurs when a general lowering of the ground water arises naturally from drought.

The actual drying of the ground is a condition which is favorable to the general good health in this country, and this circumstance often masks, in the general death-rate, the potential influence of certain diseases, so that the general health of a district appears to be good, while at the time it may suffer intensely from a certain class of disease of which low ground water is the indicator. When, however, the conditions become extremely intense, and the ground water exceptionally low, the influences at work affect the death-rates as a whole. On the other hand, in periods of excessive rain with high ground water, the conditions are usually favorable to health, and all places in which the ground waters are of a uniform level, such as seaside places, which are governed by the mean tide level, and river valleys with porous soils, like that of the River Wandle, in which the water is headed up to a uniform level by mills, are usually healthy.

It is known that the measure of the effect of the ground water is most marked in districts which draw their water supply from the ground, and amongst that section of the inhabitants who use such water for dietetic and other purposes, especially in the case of young children and teetotallers.

The unhealthy time after the period of excessive low water is that when the first rain begins to percolate through the soil, just as if it washed out matters which had been specially prepared or were retained in the dark recesses of the soil, into the water, or by driving out the ground air specially charged with the poison of disease. It is by no means uncommon both in this and other countries to find that particular epidemic outbreaks which have become rife at a low-water period can be traced to particular rainfalls. In this country since we have the registration of deaths, those quarters of the year when percolation has first commenced after periods of exceptionally low water are, without exception, the most unhealthy seasons that have been recorded. The quarters of the year when percolation first commenced after exceptionally low water have been the most unhealthy, as, for example, the

[1] Abstract of a paper read before the Congress of Hygiene, in London, England, August, 1891, by Baldwin Latham, F.G.S.

March quarters of 1838, 1845, 1847, 1853, 1855, 1864, 1865, 1866, 1875, 1890, 1891, which, with the exception of the third quarter of 1849 (the cholera year), are the most fatal seasons on record.

There is no doubt that the sanitary condition of the district greatly influences the results of the movements of the ground water, and the greater the amount of disturbance or the number of disturbances of the ground water in the course of the season in insanitary districts, the greater and more marked the influence upon health until the period arrives when the soil has been washed free from its impurities, and the waters have accumulated in the ground.

Certain diseases have their allotted seasons and conditions favorable for their development and spread, and there are a number of diseases usually most rife when the ground waters are low, such as enteric fever, cholera, small-pox, diphtheria, and others.

The state of low ground water as being a condition accompanying epidemics of typhoid fever is a matter of constant observation, and it is a well-authenticated fact that all epidemics of this disease in this country have occurred in periods only of low water, or when immediately following a very low state of the ground water.

Ground water influences both small-pox and diphtheria in a most marked manner, but in directly opposite ways, so that when one of these diseases is present the other is absent. Small-pox is accompanied or preceded by intense dryness of the ground, while diphtheria occurs only when the condition of the ground is one of continued dampness. The year 1871 was a very fatal year from small-pox in this country, and in that year the percolation experiments showed that the ground was intensely dry. In 1876 an outbreak of small-pox occurred at Croydon, and continued until the autumn of 1877. Outbreaks of this disease have subsequently occurred in this place in 1881–82 and 1884–85. Since September, 1885, there have been no deaths recorded from small-pox at Croydon, but diphtheria has been very prevalent during the whole of that period, and the ground has been in a constant state of dampness, so much so, that, with the exception of one month, October, 1886, a measurable quantity of water flowed from the percolation gauges every month during all this long period. The last outbreak of small-pox in 1884–85 was preceded by seven months, and that of 1881–82 by five months, when no water percolated through the ground.

Since the time when the author first observed this marked coincidence between the dryness of the ground and outbreaks of small-pox, he has learned from the report of Surgeon-Major G. Hutcheson, M.D., Sanitary Commissioner of the North-western Provinces and Oudh, that the counterpart of this has been observed in India in reference to small-pox, which, it is stated, "is controlled or kept in abeyance by damp and moisture."

The most marked incident in connection with ground water is the remarkable parallelism between the deaths of children under five years of age and the lowness of the ground water; in fact, it is found that the deaths in this case fluctuate inversely in proportion to the volume of the water in the ground.

In 1882 the excess of deaths was no doubt due to the direct pollution of the water-supply of the district. And it should be observed that since 1884 the low waters in this well are lower than would be the case naturally, as since this period the waters have been abnormally lowered by the establishment of the New Croydon Water Works Company's station at Addington. If the deaths from diarrhœa are eliminated as being affected more by temperature than by conditions affecting the state of the ground water, the parallelism between the volume of water in the ground and the death-rate becomes even more marked.

This coincidence between the rates of mortality of children and ground water occurring period after period is tantamount to positive proof that ground water, at least, if not the direct cause, is the measure of the influences at work which seriously menace the lives of young persons.

Those who require further information upon this subject will find it in the author's recent presidential address to the Royal Meteorological Society.

NOTES AND NEWS.

THE *Annals of Hygiene* states that the legislature of Michigan has recently passed a bill making it a misdemeanor, punishable by fine and imprisonment, to manufacture or sell, give or deliver, cigarettes of any kind of tobacco, or cigarette paper in books or blocks for wrapping cigarettes.

— The operations of the Geological Survey of Missouri during the month of August were as follows: Examinations of the zinc and lead deposits have been extended into Greene, Stone, Webster, Howell, Oregon, Carter, Texas, Wright, and Shannon Counties; inspections of iron ores have been made in Cape Girardeau, Bollinger, Wayne, Stoddard, Reynolds, Carter, Ripley, Shannon, and Howell Counties; detailed mapping has been prosecuted in Macon, Chariton, and Henry Counties, and about 70 square miles have been covered. The study of the Quaternary deposits has been continued over the central portion of the State adjacent to the Missouri River; and the mapping of the crystalline rocks has been continued in Madison, St. Francois, Washington, Iron, and Reynolds Counties, as has also the geological mapping in Greene County. For the purpose of constructing models illustrating the conditions of occurrence of ore bodies, detailed surveys have been completed of two important iron deposits. In the laboratory, analyses have been made of clays and iron ores; in the office the plotting of maps preparatory to publication has proceeded uninterruptedly, and work has been continued on the preparation of the report on paleontology. With reference to future work, steps have been taken towards securing for the State the determination of the latitude and longitude of a series of points, which determinations are necessary for the further prosecution of the detailed mapping now in progress.

— Persistent attempts have been made to produce a good artificial substitute for ivory. Hitherto none have been successful. A patent has recently been taken out, says the *Engineer*, for a process based upon the employment of those materials of which natural ivory is composed, consisting, as it does, of tribasic phosphate of lime, calcium carbonate, magnesia, alumina, gelatine, and albumen. By this process, quicklime is first treated with sufficient water to convert it into the hydrate, but before it has become completely hydrated, or "slaked," an aqueous solution of phosphoric acid is poured on to it; and while stirring the mixture the calcium carbonate, magnesia, and alumina are incorporated in small quantities at a time; and lastly the gelatine and albumen dissolved in water are added. The point to aim at is to obtain a compost sufficiently plastic and as intimately mixed as possible. It is then set aside to allow the phosphoric acid to complete its action upon the chalk. The following day the mixture, while still plastic, is pressed into the desired form in moulds, and dried in a current of air at a temperature of about 150° C. To complete the preparation of the artificial product by this process, it is kept for three or four weeks, during which time it becomes perfectly hard. The following are the proportions for the mixture, which can be colored by the addition of suitable substances: quicklime, 100 parts; water, 300 parts; phosphoric acid solution, 1.05 sp. gr., 75 parts; calcium carbonate, 16 parts; magnesia, 1 to 2 parts; alumina, precipitated, 5 parts; gelatine, 15 parts.

— In a paper read before the American Association for the Advancement of Science at the recent meeting in Washington, Professor Joseph James gave the results of a visit to Point Pleasant, Ohio, made to ascertain the age of the rocks. The paper has just been printed in full in the Journal of the Cincinnati Society of Natural History. In it is given a notice of such papers as have considered any of the rocks of south-western Ohio to be of earlier age than the Hudson River group of New York. There are also given the details of a section studied by him at Point Pleasant during the summer of 1890. Vanuxem, in 1829, was the first to correlate the Cincinnati strata with the Trenton of New York, and he was followed in this by Conrad in 1841. In 1843 Hall referred the rocks to the Hudson River group of New York. In 1865 Meek and Worthen proposed for the series the name Cincinnati group. This name was generally accepted, but in 1879 a committee of the Cincinnati Society of Natural History advocated abandoning the term Cincinnati, and substituting Hudson River and Utica slate. The committee also supposed the Trenton was exposed on the Ohio River twenty or twenty-five miles above the city. This opinion was adopted by Professor Orton and others, but Professor James concludes that there is no difference between the lowest beds exposed on the Ohio at Cincinnati and the rocks at Point Pleasant. He says the beds of the two localities cannot be placed in two separate terranes unless an arbitrary line be drawn at some point in the series. The paper is illustrated by two plates of views of the strata at Point Pleasant, and at Ludlow, Ky., opposite Cincinnati.

— A German specialist, Dr. Cold, has recently pleaded for giving young people more sleep. A healthy infant sleeps most of the time during the first weeks, and, in the early years, people are disposed to let children sleep as much as they will. But from six or seven, when school begins, there is a complete change. At the age of ten or eleven the child sleeps only eight or nine hours, when he needs at least ten or eleven, and as he grows older the time of rest is shortened. Dr. Cold believes, according to *Nature*, that up to twenty a youth needs nine hours' sleep, and an adult should have eight or nine. With insufficient sleep, the nervous system, and brain especially, not resting enough, and ceasing to work normally, we find exhaustion, excitability, and intellectual disorders gradually taking the place of love of work, general well-being, and the spirit of initiative.

— An interesting paper upon the slow combustion of explosive gas mixtures (of which *Nature* gives a brief abstract) is contributed to the current number of *Liebig's Annalen* by Dr. Krause and Professor Victor Meyer. The experiments described were made with electrolytic mixtures of hydrogen and oxygen, and denotating mixtures of carbon monoxide and oxygen. The first experiment consisted in heating in a bath of vapor of diphenylamine (305°) a denotating mixture of hydrogen and oxygen contained in a U-shaped tube closed by mercury. The heating was continued without intermission for a fortnight, at the end of which time very little gas remained, almost the whole having slowly combined to form water. The experiment was then repeated in an apparatus constructed entirely of glass, and in which the use of mercury was avoided, except in a small manometer used to indicate the pressure. It was then found that no trace of water was formed at the temperature of diphenylamine vapor (305° C.); at the temperature of boiling sulphur (448°) the amount of combination was exceedingly small; while at 518°, the boiling-point of phosphorus pentasulphide, a considerable amount of combination occurred, but no quantitative rule could be deduced. In all these experiments the gases employed were moist, and no particular care had been taken to remove the last traces of admixed air. Now Bunsen and Roscoe, in their celebrated work on denotating mixtures of hydrogen and chlorine, showed that regular results were only obtained when the film of air condensed upon the surfaces of the glass vessels employed was removed by allowing the gas to stream through the apparatus for several days previous to the experiment. A fresh series of experiments were therefore made, in which these precautions were most rigidly observed; most complicated pieces of apparatus were constructed of glass throughout, which admitted of the drying of the gases prepared (in case of hydrogen and oxygen) by the electrolysis of hot water, so as to exclude ozone and hydrogen peroxide; and the pure gases thus obtained were allowed to stream through the series of bulbs united by capillary tubes for a fortnight, night and day, before the bulbs were sealed off at the capillaries. It was found that, with pure dry gases, scarcely a trace of combination occurred by the fusion of the very fine capillaries. As regards the temperature of ignition of electrolytic hydrogen and oxygen, or denotating carbon monoxide and oxygen, it was found that bulbs containing them do not explode when placed in boiling pentasulphide of phosphorus (518°), but do explode in vapor of stannous chloride (606°). The temperature of ignition lies, therefore, between 518° and 606° C. The mode of explosion differs considerably under different circumstances. In case of explosion in vapor of stannous chloride, the bulb was never shattered, but a sudden appearance of flame within the bulb occurred, accompanied by a slight detonation, and in some cases the point of the capillary was blown off. It is also astonishing how long one requires to hold such a bulb in a Bunsen flame before explosion occurs; it never occurs until the flame becomes colored yellow, and the glass begins to soften, and frequently only causes a swelling out of the glass at the heated spot. Thin-walled bulbs, however, are sometimes shattered. In two cases it was noticed that the glass at the softened part was violently forced in, owing to the previous heating having caused a large percentage of combination, and hence the production of a partial vacuum. Even after taking the rigid precautions to insure purity above described, no definite quantitative rule connecting the time and percentage of combination has been discovered, experiments performed simultaneously upon similarly treated mixtures yielding widely different results; showing that the irregularities of glass surfaces, even after removal of their air-films, are quite sufficient to modify very sensibly the conditions under which combination occurs.

— The settlement founded by Mrs. Humphry Ward, on the principles laid down in "Robert Elsmere," and which has its home in University Hall, Gordon Square, London, has shown itself intellectually active during the last year, according to the London *Journal of Education*. The warden, the Rev. Philip Wicksteed, M.A., has completed his arrangements for the winter lectures. He will himself undertake a course of lectures on Dante. Mr. Wicksteed has been for some years a university extension lecturer, and is one of the foremost English exponents of Dante. The more immediate ends of the "Robert Elsmere" position will be illustrated by the warden's course on the criticism of the Old Testament. Professor Knight of St. Andrew's, whose Wordsworth studies have earned him a permanent place amongst literary men, will give a series of lectures on "Some Aspects of Theism," a course which will be treated both historically and philosophically. Mr. R. G. Moulton, a university extension lecturer of high reputation, will treat of "The Literary Study of the Bible." The energetic warden will, further, lecture on the "Elements of Political Economy." One of the great difficulties for the ordinary man in the study of economics is the development of the mathematical exposition of the subject. Thus Professor Jevon's "Theory" is founded on mathematics; so, too, the notes and appendices of Professor Marshall's "Economics" are mathematical in treatment. To meet the needs of those whose mathematics are shaky, a class will be held after lectures, so as to enable all to follow, as closely as possible, modern theoretical economics

— In a lecture on "Old-time Winters in Essex County," delivered before the Essex (Mass.) Institute in May last, Mr. Perley gave interesting particulars on many subjects, including weather, some of which appear in the bulletin of the institute. The lecturer spoke of the watch, church services, dress, food, and schools of the early winter seasons; how the people spent their evenings, the winter employment of the people in cutting off the forests, sledding timber and wood, making pipe staves and barrel hoops, and, most interesting of all, the institution of the old-fashioned shoemakers' shops, of which nearly every farm had one a century ago. Women in those days engaged in spinning and weaving. The holidays were referred to, Thanksgiving, Christmas, and New Year's; and the winter's pleasures, such as sleigh-rides, dancing, spinning and quilting parties, and games, shuffle-board, coasting, skating, trapping, gunning, fishing, singing-schools, and girls' samplers. He also spoke of the old modes of travel, snow-shoes, etc. Nearly all the heavy teaming was done on sleds, and he mentioned the winter of 1768–69, when the travelling was so bad that the farmers in the western part of the State could not get their grain and provisions to the coast to market. Snow remained on the roads as it fell until about a century ago. Mr. Perley then spoke of particular winters: that of 1641–42, when the Indians said they had not seen the ocean so much frozen for forty years; of 1646–47, when there was no snow to lay; of 1696–97, said to be the coldest winter since the first settlement of New England; of 1701–2, which was "turned into summer;" of 1717–18, when the snow was from ten to fifteen feet deep and the drifts twenty-five feet, many one-story houses being buried; of 1740-41, said to be the severest winter known by the settlers, Salem harbor being frozen over as early as October; of 1774–75, a wonderfully mild winter; of 1779-80, when for forty days, including March, there was no perceptible thaw, and the snow was so hard and deep that loaded teams passed over the fences in any direction, arches being dug under the snow so that men on horseback could ride under them, and which was long remembered as *the* hard winter; of 1784-85, when, as late as April 15, snow was two feet deep, and frozen hard enough to bear cattle; of 1785-86, when in the remarkable storm of Nov. 25, the snow blew into balls, one of which had rolled seventy-six feet, measuring seventeen and a half by twenty-two inches; of 1794-95, when the "Betsey" was launched in Salem on Christmas Day, the thermometer indicating 80° above zero at noon, and men and boys went in swimming; of 1801-2, when the "Ulysses," "Brutus," and "Volutia," three Salem vessels, which sailed out of the harbor on a summer-like morning in February, were all cast away at night on Cape Cod, in a terrible snow-storm, which continued a week. He also referred to more recent seasons, and to the cold winter of 1856-57, when in one week in January was the coldest day by the thermometer ever recorded of late years, mercury in Salem 20° below zero; travel on the railroad between Boston and Salem entirely suspended from Tuesday morning to Thursday afternoon. The recent mild winters were also alluded to.

— At the Bournemouth meeting of the British Medical Association, a discussion on the subject of alcohol was initiated by a paper by Dr. Samuel Wilks. In the course of his paper, as we learn from *Nature*, he stated that he had no acquaintance with any organic changes attributable to alcohol in the lungs and kidneys, but it seemed that the digestive and nervous systems suffered. Physiologists had failed to demonstrate the chemical changes which it underwent in the body, and consequently it was impossible to say whether it was of the nature of a food or not. No one had yet seen a person who lived on alcohol, although there was evidence of persons taking large quantities of alcohol who yet preserved their weight with a minimum of food; and that supported the theory that, although alcohol was not nutritive in itself, it prevented the wear and tear of the body. The opposite theory also existed, that alcohol acted as a spur to the nervous system and quickly wore it out. He could not disapprove of the use of wine and beer, if taken in moderation, by the masses of the people; but as to spirits, or spirits and water, he had not made up his mind that they were in any way useful, and he seldom recommended them. Dr. Bucknill thought that the wise use of wine might cure some cases and be useful in others. Dr. Norman Kerr said that alcohol was a poison, analogous in many respects to other poisons. Sir Risdom Bennett agreed with Dr. Wilks in not approving of spirits as a beverage. He believed it to be useful in fever and in some nervous diseases, but he did not think it desirable at the present time to lay down any broad principles with regard to alcohol with reference to the whole community.

— In the hamlet of Sewardstone, England (as we learn from *Amateur Gardening*), Mr. W. Melles, J.P., the leading landowner in the district, has, at his own expense, supplied and planted a collection of apples, pears, plums, cherries, and bush fruits for the purpose of enabling the principles of fruit culture to form part of the educational curriculum at the Sewardstone Board School. The collection embraces all the most useful varieties, and the trees are planted in such a manner that they form a border of some width to the spacious playground. The boys and girls will share in the work of attending to the culture of these trees, and on certain days the head master, Mr. Spink, who is an enthusiast on the subject, will give lessons on theory and practice. Mr. Spink has drawn up a graduated scheme for teaching fruit culture as a specific subject to his scholars, and this is being submitted to the inspectors for their approval, so that the children may in due course be examined thereon. According to Mr. Spink's scheme, the children will first be taught the botany of an apple blossom and fruit, followed by difference between seedling and parent, planting, mulching, summer and winter pruning, thinning the fruit, insect pests, packing, and storing the fruit: this will constitute the first stage. The second stage will deal with the food of fruit trees, manures, course of sap; and the third, the art of propagation. The first stage in the scheme covers a variety of subjects, but Mr. Spink has been obliged to do this because most of the boys leave the schools when they have passed the fifth standard, and hence it is needful to let them know as much of the first stage as possible before they do so. This is an excellent idea, and one which might be followed with advantage by other schools in country districts. "The exterior walls of schools might be turned to good account for growing peaches, apricots, and the finer kinds of pears and plums. If the head master could not undertake the practical management of such trees, some of the gentlemen who reside in the parish would, in such a case, be doing an excellent service by allowing their gardener to pay occasional visits, and advise, as well as give practical illustrations of the systems of pruning, disbudding, etc. If the correct principles of fruit culture could only be firmly instilled in the minds of boys and girls when at school, they would grow up into men and women armed with information that would, whether as servants or masters, be of the greatest possible value to them and to the welfare of the country generally."

— The *Photographic News* says that the great progress that has been made in the methods by which rapid movements can be analyzed is well seen in a series of photographs lately taken by Anchütz of Lissa, who has already given to the world some of the best instantaneous pictures ever taken. The subject of the pictures at present under consideration is a dog jumping over a small bush. In the act of making one jump the animal has been photographed twenty-four separate times, and each picture is not a mere silhouette, as was the case with Muybridge's first attempts of this kind, but a little picture showing half-tone and detail. Some of the attitudes are, of course, comic in appearance, for they represent phases of a movement which the eye is unaccustomed to, and cannot possibly appreciate. Notably is this the case in the commencement of the jump, when the dog's hind toes only touch the ground; and again at the finish of the jump, when his legs are gathered together in a heap.

— We have received from Mr. Mostyn, says *Nature*, an interesting letter on the well-known appearance of the green ray at sunrise or sunset caused by the refraction of the air. He states: "This 'green ray' is seen to best advantage at sun-*rise*, owing, I imagine, to the eye not being wearied with watching the previous glare, as is apt to be the case at sunset. At the same time, I had many very satisfactory observations at sunset, one in particular, when we were running before a very heavy sea in the Southern Ocean, and the 'green ray' was seen no less than three times in as many seconds, as the ship rose and fell on the huge waves, causing as it were two sunsets, with a sunrise between them. The best displays took place when the refraction near the horizon was of such a character that the sun assumed a balloon, or vase, shape as he came close to the sea-line. When, on the contrary, the sun appeared flattened out in its horizontal diameter, the 'green ray' was either entirely absent, or was seen only in an indistinct and uncertain manner."

— Public interest in industrial and commercial exhibitions will doubtless be somewhat stimulated this year by the extensive preparations now making for the World's Columbian Exhibition at Chicago. Among the many attractions of this kind offered to the public, and presenting valuable opportunities to inventors and artisans ready to invite attention to their work, perhaps there are none which have a longer or more useful record than the annual fairs of the American Institute of this city. The sixtieth exhibition of the institute will open this year on Sept. 30, and continue in operation until Nov. 28, giving two months' time to exhibitors improving the full period. The general superintendent, Mr. Charles Wager Hull, is ready at the offices of the institute, No. 113 West 38th Street, to give information and receive applications for space. The fair will be held in the Exhibition Hall on Third Avenue, which is now open for the reception of machinery. Other exhibits will be received on and after the 21st. The entries for the forthcoming exhibition already show a continued interest in the American Institute, and indicate that the exhibition of the present year will be in no respect less successful than its many predecessors.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

THE QUESTION OF A TABLE AT THE NAPLES STATION.

At present, as we learn from a statement recently made by Professor Sclater in *Nature*, the zoological station at Naples rents continuously about twenty tables, each at $500 a year. These tables are rented to different States and universities of Europe, as follows: Prussia, 4; Baden, 1; Bavaria, 1; Saxony, 1; Hesse, 1; Wurtemberg, 1; Italy, 7; Switzerland, 1; Hungary, 1; Holland, 1; University of Cambridge (England), 1; British Association, 1. Besides these twenty-one regular rents, a number of others, varying from eight to sixteen, are made every year to some or all of the following governments: Russia, Belgium, Austria, Spain, and some Italian provincial governments. The average number disposed of in this way is estimated at ten, making the total number thirty-one. The annual income from tables would thus amount to about $15,000 a year. The revenue from the sale of preserved specimens amounts to about $3,500, while the receipts from the admission of visitors to the aquarium amounts to about $5,000. The whole income is thus approximately $24,000. But the annual expenditure of the station has now reached $32,000, so that there is a deficit of from $8,000 to $10,000 to meet. This heavy deficit is met every year by a subsidy from the German government. "This is a good example," says Professor Sclater, "of the liberal way in which science is encouraged and supported in the 'Fatherland,' and is the more noteworthy because the object of its well-bestowed bounty in this instance is localized on foreign soil."

Indeed, this is a splendid example of the high appreciation in which pure scientific research is held by an enlightened government — an example which we should be glad to see followed in this country.

But what interest has America taken in the Naples station? With the single exception of Williams College, which rented a table for one year, our colleges and universities have contributed nothing towards maintaining this magnificent establishment. A considerable number of American zoölogists have been permitted to occupy tables at the station, free of charge, through the generous courtesy of its director and founder, Dr. Dohrn. While we have been the recipients of such exceptional favors for some ten or fifteen years, we have thus far, for some reason or no reason, failed to take any decided action towards securing a permanent table. During the past year a table has been supported through the liberality of Maj. Alex. Henry Davis of Syracuse, and the hope has been entertained that the praiseworthy initiative of Maj. Davis would lead, in one way or other, to the continued maintenance of an American table. The matter was brought before the American Association for the Advancement of Science, at its recent session in Washington, by Dr. Stiles, and the association responded to the appeal by offering to contribute $100 towards the subscription. This leaves $400 to be obtained elsewhere. It is a pity that the American Association could not, as the British Association does, take a whole table instead of one-fifth of a table. Possibly at the next session the association may be able to increase its offer to the full subscription, and thus one table be secured, so that the American student who goes to Naples for biological study will not have to feel the long-standing reproach that his country has done nothing to support the only international biological station in existence. Meanwhile the question arises, shall we not try to raise at once the amount required for a table this year? As one of our morphologists desires to spend the winter in embryological research at Naples, and as we have already placed ourselves under repeated obligation to the station, it seems that immediate action ought to be taken, and I most heartily approve of the effort of Dr. Stiles to procure by subscription the needed sum.

The only objection — if such it is worthy to be called — likely to arise is that we have pressing home needs that might be said to claim first attention. But great and urgent as these needs unquestionably are, I see no reason to suppose that we should reach them sooner by neglecting a plain duty to the Naples station. On the contrary, I believe that the national interest which some of us have most at heart is so intimately related to the international interest, that what we accomplish for the one will redound to the good of the other.

Perhaps a movement in behalf of the Naples station may encounter a little national prejudice, or possibly a narrower feeling that is still more foreign to the catholicity of a scientific brotherhood.

The sentiment to which Dr. Dohrn gave expression in a recent number of *Nature* deserves to be repeated here. "I think," says Dr. Dohrn, "the time has come when one must raise one's voice most distinctly against the narrowing limits of national prejudice, which nowadays has grown to almost overwhelming and even pernicious importance in many provinces of material, and — I am sorry to say — also moral and intellectual existence. Science at any rate ought to be exempt from that morbid exclusiveness which refuses to act in rational community regardless of political or ethnographical boundaries."

C. O. Whitman.

"The Century Dictionary" is at last completed; the sixth and concluding volume will soon be brought out, the final pages being now on the press. The work contains about 500 more pages and 2,000 more illustrations than were originally promised.

ENDOWED RESEARCH IN PHYSICS.[1]

THERE is a subject which has long been in my mind, and which I determined to bring forward whenever I had a cathedral opportunity of doing so; and now, if ever, is a suitable occasion. It is to call attention to the fact that the further progress of physical science in the somewhat haphazard and amateur fashion in which it has been hitherto pursued in this country is becoming increasingly difficult, and that the quantitative portion especially should be undertaken in a permanent and publicly-supported physical laboratory on a large scale. If such an establishment were to weaken the sinews of private enterprise and individual research it should be strenuously opposed; but, in my opinion, it would have the opposite effect, by relieving the private worker of much which he can only with great difficulty, sacrifice, and expense, undertake. To illustrate more precisely what I mean, it is sufficient to recall the case of astronomy. The amateur astronomer has much work lying ready to his hand, and he grapples with it manfully. To him is left the striking out of new lines and the guerilla warfare of science. Skirmishing and brilliant cavalry evolutions are his natural field; he should not be called upon to take part in the general infantry advance. It is wasting his energies, and he could not do it in the long run well. What, for instance, would have been the state of astronometry — the nautical almanac department of astronomy — without the consecutive and systematic work of the National Observatory at Greenwich? It may be that some enthusiastic amateurs would have devoted their lives to this routine kind of work, and here at one time and there at another a series of accurate observations would have been kept for several years. Pursued in that way, however, not only would the effort be spasmodic and temporary, but the energy and enthusiasm of those amateurs would have been diverted from the pioneering more suited to them, and have been cramped in the groove of routine, eminently adapted to a permanent official staff, but not wholesome for an individual.

Long-continued consecutive observations may be made by a leader of science, as functions may be tabulated by an eminent mathematician; but if the work can be done almost equally well (some would say better) by a professional observer or computator, how great an economy results.

Now all this applies equally to physics. The ohm has been determined with 4-figure, perhaps with 5-figure, accuracy; but think of the list of eminent men to whose severe personal labor we owe this result, and ask if the spoil is worth the cost. Perhaps in this case it is, as a specimen of a well-conducted determination. We must have a few specimens, and our leaders must show us the way to do things. But let us not continue to use them for such purposes much longer. The quest of the fifth or sixth decimal is a very legitimate, and may become a very absorbing, quest, but there are plenty of the rank and file who can undertake it if properly generalled and led; not as isolated individuals, but as workers in a National Laboratory under a competent head and a governing committee. By this means work far greater in quantity, and in the long run more exact in quality, can be turned out, by patient and conscientious labor without much genius, by the gradual improvement of instrumental means, by the skill acquired by practice, and by the steady drudgery of routine. Paris has long had one form of such an institution, in the Conservatoire des Arts et Métiers, and has been able to impose the metric system on the civilized world in consequence. It can also point to the classical determinations of Regnault as the fruits of just such a system. Berlin is now starting a similar or a more ambitious scheme for a permanent national physical institute. Is it not time that England, who in physical science, I venture to think, may in some sort claim a leading place, should be thinking of starting the same movement?

The Meteorological and Magnetic Observatory at Kew (in the inauguration of which this association took so large a part) is a step, and much useful quantitative work is done there. The new Electric Standardizing Laboratory of the Board of Trade is another, and, in some respects perhaps, a still closer approximation to the kind of thing I advocate. But what I want to see is a much larger establishment erected on the most suitable site, limited by no specialty of aim nor by the demands of the commercial world, furnished with all appropriate appliances, to be amended and added to as time goes on and experience grows, and invested with all the dignity and permanence of a national institution: a physical laboratory, in fact, precisely comparable to the Greenwich observatory, and aiming at the very highest quantitative work in all departments of physical science. That the arts may be benefitted may be assumed without proof. It is largely the necessity of engineers that has inspired the amount of accuracy in electrical matters already attained. The work and appliances of the mechanical engineer eclipse the present achievements of the physicist in point of accuracy, and it is by the aid of the mechanician and optician that precision even in astronomy has reached so high a stage. There is no reason why physical determinations should be conducted in an amateur fashion, with comparatively imperfect instruments, as at present they mostly are. Discoveries lie along the path of extreme accuracy, and they will turn up in the most unexpected way. The aberration of light would not have been discovered had not Bradley been able to measure to less than 1 part in 10,000; and what a brilliant and momentous discovery it was! He was aiming at the detection of stellar parallax. This is the type of result which sometimes lurks in the fifth decimal, and which confers upon it an importance beside which the demands of men who wish to serve the taste and the pocket of the British public sink into insignificance.

In a national observatory accuracy should be the one great end; the utmost accuracy in every determination that is decided on and made. Only one thing should be more thought of than the fifth significant figure, and that is the sixth. The consequences flowing from the results may safely be left; such as are not obvious at once will distil themselves out in time. And the great army of outside physicists, assured of the good work being done at headquarters, will (to speak again in astronomical parable) cease from peddling with taking transits or altitudes, and will be free to discover comets, to invent the spectroscope, to watch solar phenomena, to chemically analyze the stars, to devise celestial photography, and to elaborate still more celestial theories; all of which novelties in their maturity may be handed over to the national observatory, to be henceforth incorporated with, and made part of, its routine life; leaving the advance guard and skirmishers free to explore fresh territory, secure in the knowledge that what they have acquired will be properly surveyed, mapped, and utilized, without further attention from them.

As to the practical applications, they may in any case be left to take care of themselves. The instinct of humanity in

[1] Abstract of an address before the section of Mathematics and Physics of the British Association for the Advancement of Science, at Cardiff, August, 1891, by Professor Oliver J. Lodge, president of the section (Nature, Aug. 20).

this direction, and the so-called solid gains associated with practical achievements, will always secure a sufficient number of acute and energetic workers to turn the new territory into arable land and pasture adapted to the demands of the average man. The labor of the agriculturist in rendering soil fertile is, of course, beyond praise; but it is not the work of the pioneer. As Mr. Huxley eloquently put it, when contrasting the application of science with the advance of science itself, speaking of the things of commercial value which the physical philosopher sometimes discovers: "Great is the rejoicing of those who are benefitted thereby, and, for the moment, science is the Diana of all the craftsmen. But even while the cries of jubilation resound, and the flotsam and jetsam of the tide of investigation is being turned into the wages of workmen and wealth of capitalists, the crest of the wave of scientific investigation is far away on its course over the illimitable ocean of the unknown."

I have spoken of the work of the national laboratory as devoted to accuracy. It is hardly necessary to say that it will be also the natural custodian of our standards, in a state fit for use and for comparison with copies sent to be certified. Else perhaps some day our standard ohm may be buried in a brick wall at Westminster, and no one living may be able to recall precisely where it is.

But, in addition to these main functions, there is another, equally important with them, to which I must briefly refer. There are many experiments which cannot possibly be conducted by an individual, because forty or fifty years is not long enough for them. Secular experiments on the properties of materials — the elasticity of metals, for instance; the effect of time on molecular arrangement; the influence of long exposure to light, or to heat, or to mechanical vibration, or to other physical agents.

Does the permeability of soft iron decay with age, by reason of the gradual cessation of its ampèrian currents? Do gases cool themselves when adiabatically preserved, by reason of imperfect elasticity or too many degrees of freedom of their molecules? Unlikely, but not impossible. Do thermoelectric properties alter with time? And a multitude of other experiments which appear specially applicable to substances in the solid state — a state which is more complicated, and has been less investigated, than either the liquid or the gaseous; a state in which time and past history play an important part.

Whichever of these long researches requires to be entered on, a national laboratory, with permanent traditions and a continuous life, is undoubtedly the only appropriate place. At such a place as Glasgow the exceptional magnitude of a present occupant may indeed inspire sufficient piety in a successor to secure the continuance of what has been there begun; but in most college laboratories, under conditions of migration, interregnum, and a new *régime*, continuity of investigation is hopeless.

I have at any rate said enough to indicate the kind of work for which the establishment of a well-furnished laboratory with fully equipped staff is desirable, and I do not think that we, as a nation, shall be taking our proper share of the highest scientific work of the world until such an institution is started on its career.

There is only one evil which, so far as I can see, is to be feared from it: if ever it were allowed to impose on outside workers as a central authority, from which infallible dicta were issued, it would be an evil so great that no amount of good work carried on by it could be pleaded as sufficient mitigation.

If ever by evil chance such an attitude were attempted, it must rest with the workers of the future to see that they permit no such shackles; for if they are not competent to be independent, and to contemn the voice of authority speaking as mere authority, if their only safeguard lies in the absence of necessity for struggle and effort, they cannot long hope to escape from the futility which surely awaits them in other directions.

I am thus led to take a wider range, and, leaving temporary and special considerations, to speak of a topic which is as yet beyond the pale of scientific orthodoxy, and which I might, more wisely, leave lying by the roadside. I will, however, take the risk of introducing a rather ill-favored and disreputable looking stranger to your consideration, in the belief — I might say, in the assured conviction — that he is not all scamp, and that his present condition is as much due to our long-continued neglect as to any inherent incapacity for improvement in the subject.

I wish, however, strenuously to guard against its being supposed that this association, in its corporate capacity, lends its countenance to, or looks with any favor on, the outcast. What I have to say — and, after all, it will not be much — must rest on my own responsibility. I should be very sorry for any adventitious weight to attach to my observations on forbidden topics from the accident of their being delivered from this chair. The objection to which I have now hinted is the only one that seems to have any just weight, and on all other counts I am willing to incur such amount of opprobrium as naturally attaches to those who enter on a region where the fires of controversy are not extinct, and in which it is quite impossible, as well as undesirable, for every one to think alike.

It is but a platitude to say that our clear and conscious aim should always be truth, and that no lower or meaner standard should ever be allowed to obtrude itself before us. Our ancestors fought hard and suffered much for the privilege of free and open inquiry, for the right of conducting investigations untrammelled by prejudice and foregone conclusions, and they were ready to examine into any phenomenon which presented itself. This attitude of mind is perhaps necessarily less prominent now, when so much knowledge has been gained, and when the labors of many individuals may be rightly directed entirely to its systematization and a study of its inner ramifications; but it would be a great pity if a too absorbed attention to what has already been acquired, and to the fringe of territory lying immediately adjacent thereto, were to end in our losing the power of raising our eyes and receiving evidence of a totally fresh kind, of perceiving the existence of regions into which the same processes of inquiry as had proved so fruitful might be extended, with results at present incalculable and perhaps wholly unexpected. I myself think that the ordinary processes of observation and experiment are establishing the existence of such a region; that, in fact, they have already established the truth of some phenomena not at present contemplated by science, and to which the orthodox man shuts his ears.

For instance, there is a question whether it has or has not been established by direct experiment that a method of communication exists between mind and mind irrespective of the ordinary channels of consciousness and the known organs of sense, and, if so, what is the process. It can hardly be through some unknown sense organ, but it may be by some direct physical influence on the ether, or it may be in some still more subtle manner. Of the process I as yet know nothing. For brevity it may be styled "thought-transference," though the name may turn out to be an unsuitable one after further investigation. Further investigation is just what is wanted. No one can expect others to accept his word for an entirely new fact, except as establishing a *prima facie* case for investigation.

But I am only now taking this as an instance of what I mean; whether it be a truth or a fiction, there is not, I suppose, one of the recognized scientific societies who would receive a paper on the subject. (This, however, is mere conjecture. I am not aware that the experiment has been tried.) There are individual scientific men who have investigated these matters for themselves; there are others who are willing to receive evidence, who hold their minds open and their judgment in suspense; but these are only individuals. The great majority, I think I am right in saying, feel active hostility to these researches and a determined opposition to the reception or discussion of evidence. And they feel this confirmed scepticism, as they call it, not after prolonged investigation, for then it might be justified, but sometimes after no investigation at all. A few tricks at a public performance, or the artifices of some impostor, and they decline to consider the matter further.

That individuals should take this line is, however, natural enough; they may be otherwise occupied and interested. Everybody is by no means bound to investigate everything; though, indeed, it is customary in most fields of knowledge for those who have kept aloof from a particular inquiry to defer in moderation to those who have conducted it, without feeling themselves called upon to express an opinion. Some there are, no doubt, who consider that they have given sufficient time and attention to the subject with only negative results. Their evidence is, of course, important; but plainly, negative evidence should be of immense bulk and weight before it can outweigh even a moderate amount of positive evidence. However, it is not of the action of individuals that I wish to speak, it is of the attitude to be adopted by scientific bodies in their corporate capacity; and for a corporate body of men of science, inheritors of the hard-won tradition of free and fearless inquiry into the facts of nature untrammelled by prejudice, for any such body to decline to receive evidence laboriously attained and discreetly and inoffensively presented by observers of accepted competency in other branches, would be, if ever actually done and persisted in, a terrible throwing away of their prerogative, and an imitation of the errors of a school of thought against which the struggle was at one time severe.

In the early days of the Copernican theory, Galileo for some years refrained from teaching it, though fully believing its truth, because he considered that he had better get more fully settled in his university chair before evoking the storm of controversy which the abandonment of the Ptolemaic system would arouse. The same thing in very minor degree is going on to-day. I know of men who hesitate to avow interest in these new investigations (I do not mean credence — the time is too early for avowing credence in any but the most rudimentary and definitely ascertained facts — but hesitate to avow interest) until they have settled down more securely and made a name for themselves in other lines. Caution and slow progress are extremely necessary; fear of avowing interest or of examining into orthodox facts is, I venture to say, not in accordance with the highest traditions of the scientific attitude.

We are, I suppose, to some extent afraid of each other, but we are still more afraid of ourselves. We have great respect for the opinions of our elders and superiors; we find the matter distasteful to them, so we are silent. We have, moreover, a righteous mistrust of our own powers and knowledge; we perceive that it is a wide region extending into several already cultivated branches of science, that a many-sided and highly-trained mind is necessary adequately to cope with all its ramifications, that in the absence of strict inquiry imposture has been rampant in some portions of it for centuries, and that unless we are preternaturally careful we may get led into quagmires if we venture on it at all.

Now let me be more definite, and try to state what this field is, the exploration of which is regarded as so dangerous. I might call it the borderland of physics and psychology. I might call it the connection between life and energy; or the connection between mind and matter. It is an intermediate region, bounded on the north by psychology, on the south by physics, on the east by physiology, and on the west by pathology and medicine. An occasional psychologist has groped down into it and become a metaphysician. An occasional physicist has wandered up into it and lost his base, to the horror of his quondam brethren. Biologists mostly look at it askance, or deny its existence. A few medical practitioners, after long maintenance of a similar attitude, have begun to annex a portion of its western frontier. The whole region seems to be inhabited mainly by savages, many of them, so far as we can judge from a distance, given to gross superstition. It may, for all I know, have been hastily traversed, and rudely surveyed by a few clear-eyed travellers; but their legends concerning it are not very credible, certainly are not believed.

Why not leave it to the metaphysicians? I say it has been left to them long enough. They have explored it with insufficient equipment. The physical knowledge of the great philosophers has been necessarily scanty. Men of genius they were, and their writings may, when interpreted, mean much. But to us, as physicists, they are unsatisfactory; their methods are not our methods. They may be said to have floated a balloon over the region with a looking-glass attached, in which they have caught queer and fragmentary glimpses. They may have seen more than we give them credit for, but they appear to have guessed far more than they saw.

Our method is different. We prefer to creep slowly from our base of physical knowledge, to engineer carefully as we go, establishing forts, making roads, and thoroughly exploring the country, making a progress very slow, but very lasting. The psychologists from their side may meet us. I hope they will; but one or other of us ought to begin.

A vulnerable spot on our side seems to be the connection between life and energy. The conservation of energy has been so long established as to have become a commonplace. The relation of life to energy is not understood. Life is not energy, and the death of an animal affects the amount of energy no whit; yet a live animal exerts control over energy which a dead one cannot. Life is a guiding or directing principle, disturbing to the physical world but not yet given a place in the scheme of physics. The transfer of energy is accounted for by the performance of work; the guidance of energy needs no work, but demands force only. What is force? and how can living beings exert it in the way they do? An automaton worked by preceding conditions, that is, by the past, say the materialists. Are we so sure that they are not worked by the future too? In other words, that the totality of things, by which every one must admit that actions are guided, includes the future as well as the past, and that to attempt to deduce those actions from the past only will prove impossible. In some way matter can be moved, guided, disturbed, by the agency of living beings; in some way there is a control, a directing-agency active, and events are caused at its choice and will that would not otherwise happen.

A luminous and hopeful idea is that time is but a relative mode of regarding things; we progress through phenomena at a certain definite pace, and this subjective advance we interpret in an objective manner, as if events necessarily happened in this order and at this precise rate. But that may be only one mode of regarding them. The events may be in some sense existent always, both past and future, and it may be we who are arriving at them, not they which are happening. The analogy of a traveller in a railway train is useful. If he could never leave the train nor alter its pace, he would probably consider the landscapes as necessarily successive, and be unable to conceive their co-existence.

The analogy of a solid cut into sections is closer. We recognize the universe in sections, and each section we call the present. It is like the string of slices cut by a microtome; it is our way of studying the whole. But we may err in supposing that the body only exists in the slices which pass before our microscope in regular order and succession.

We perceive, therefore, a possible fourth-dimensional aspect about time, the inexorableness of whose flow may be a natural part of our present limitations. And if once we grasp the idea that past and future may be actually existing, we can recognize that they may have a controlling influence on all present action, and the two together may constitute "the higher plane," or the totality of things, after which, as it seems to me, we are impelled to seek, in connection with the directing of force or determinism, and the action of living beings consciously directed to a definite and preconceived end.

Inanimate matter is controlled by the *vis a tergo;* it is operated on solely by the past. Given certain conditions, and the effect in due time follows. Attempts have been made to apply the same principle to living and conscious beings, but without much success. These seem to work for an object, even if it be the mere seeking for food; they are controlled by the idea of something not yet palpable. Given certain conditions, and their action cannot certainly be predicted; they have a sense of option and free will. Either their actions are really arbitrary and indeterminate, which is highly improbable, or they are controlled by the future as well as by the past. Imagine beings thus controlled: automata you may still call them, but they will be living automata, and will exhibit all the characteristics of live creatures. Moreover, if they have a merely experiential knowledge, necessarily limited by memory and bounded by the past, they will be unable to predict each other's actions with any certainty, because the whole of the data are not before them. May not a clearer apprehension of the meaning of life and will and determinism be gradually reached in some such direction as this?

By what means is force exerted, and what, definitely, is force? I can hardly put the question here and now so as to be intelligible, except to those who have approached and thought over the same difficulties; but I venture to say that there is here something not provided for in the orthodox scheme of physics; that modern physics is not complete, and that a line of possible advance lies in this direction.

I might go further. Given that force can be exerted by an act of will, do we understand the mechanism by which this is done? And if there is a gap in our knowledge between the conscious idea of a motion and the liberation of muscular energy needed to accomplish it, how do we know that a body may not be moved without ordinary material contact by an act of will? I have no evidence that such a thing is possible. I have tried once or twice to observe its asserted occurrence, and failed to get anything that satisfied me. Others may have been more fortunate. In any case, I hold that we require more knowledge before we can deny the possibility. If the conservation of energy were upset by the process, we should have grounds for denying it; but nothing that we know is upset by the discovery of a novel medium of communication, perhaps some more immediate action through the ether. It is no use theorizing; it is unwise to decline to examine phenomena because we feel too sure of their impossibility. We ought to know the universe very thoroughly and completely before we take up that attitude.

Again, it is familiar that a thought may be excited in the brain of another person, transferred thither from our brain, by pulling a suitable trigger; by liberating energy in the form of sound, for instance, or by the mechanical act of writing, or in other ways. A prearranged code called language, and a material medium of communication, are the recognized methods. May there not also be an immaterial (perhaps an ethereal) medium of communication? It is possible that an idea can be transferred from one person to another by a process such as we have not yet grown accustomed to, and know practically nothing about? In this case I have evidence. I assert that I have seen it done, and am perfectly convinced of the fact. Many others are satisfied of the truth of it too. Why must we speak of it with bated breath, as of a thing of which we are ashamed! What right have we to be ashamed of a truth?

And after all, when we have grown accustomed to it, it will not seem altogether strange. It is, perhaps, a natural consequence of the community of life or family relationship running through all living beings. The transmission of life may be likened in some ways to the transmission of magnetism, and all magnets are sympathetically connected, so that, if suitably suspended, a vibration from one disturbs others, even though they be distant ninety-two million miles.

It is sometimes objected that, granting thought-transference or telepathy to be a fact, it belongs more especially to lower forms of life, and that as the cerebral hemispheres develop we become independent of it; that what we notice is the relic of a decaying faculty, not the germ of a new and fruitful sense; and that progress is not to be made by studying or attending to it. It may be that it is an immature mode of communication, adapted to lower stages of consciousness than ours, but how much can we not learn by studying immature stages? As well might the objection be urged against a study of embryology. It may, on the other hand, be an indication of a higher mode of communication, which shall survive our temporary connection with ordinary matter.

I have spoken of the apparently direct action of mind on mind, and of a possible action of mind on matter. But the whole region is unexplored territory, and it is conceivable that matter may react on mind in a way we can at present only dimly imagine. In fact, the barrier between the two may gradually melt away, as so many other barriers have done, and we may end in a wider perception of the unity of nature, such as philosophers have already dreamt of.

I care not what the end may be. I do care that the inquiry shall be conducted by us, and that we shall be free from the disgrace of jogging along accustomed roads, leaving to outsiders the work, the ridicule, and the gratification of unfolding a new region to unwilling eyes.

It may be held that such investigations are not physical and do not concern us. We cannot tell without trying. In that I trust my instinct: I believe there is something in this region which does concern us as physicists. It may concern other sciences too. It must, one would suppose, some day concern biology; but with that I have nothing to do. Biologists have their region, we have ours, and there is no need for us to hang back from an investigation because they do. Our own science of physics, or natural philosophy in its widest sense, is the king of sciences, and it is for us to lead, not to follow.

And I say, have faith in the intelligibility of the universe. Intelligibility has been the great creed in the strength of which all intellectual advance has been attempted, and all scientific progress made.

At first things always look mysterious. A comet, lightning, the aurora, the rainbow — all strange, anomalous, mysterious apparitions. But scrutinized in the dry light of science, their relationship with other better-known things becomes apparent. They cease to be anomalous; and though a certain mystery necessarily remains, it is no more a property peculiar to them, it is shared by the commonest objects of daily life.

The operations of a chemist, again, if conducted in a haphazard manner, would be an indescribable medley of effervesences, precipitations, changes in color and in substance; but, guided by a thread of theory running through them the processes fall into a series, they all become fairly intelligible, and any explosion or catastrophe that may occur is capable of explanation too.

Now I say that the doctrine of ultimate intelligibility should be pressed into other departments also. At present we hang back from whole regions of inquiry, and say they are not for us. A few we are beginning to grapple with. The nature of disease is yielding to scrutiny with fruitful result; the mental aberrations and abnormalities of hypnotism, duplex personality, and allied phenomena, are now at last being taken under the wing of science after long ridicule and contempt. The phenomenon of crime, the scientific meaning and justification of altruism, and other matters relating to life and conduct, are beginning, or perhaps are barely yet beginning, to show a vulnerable front over which the forces of science may pour.

Facts so strange that they have been called miraculous are now no longer regarded as entirely incredible. All occurrences seem reasonable when contemplated from the right point of view, and some are believed in which in their essence are still quite marvellous. Apply warmth for a given period to a sparrow's egg, and what result could be more incredible or magical if now discovered for the first time. The possibilities of the universe are as infinite as is its physical extent. Why should we grope with our eyes always downward, and deny the possibility of everything out of our accustomed beat.

If there is a puzzle about free-will, let it be attacked: puzzles mean a state of half-knowledge. By the time we can grasp something more approximating to the totality of things the paradoxity of paradoxes drops away and becomes unrecognizable. I seem to myself to catch glimpses of clews to many of these old questions, and I urge that we should trust consciousness, which has led us thus far; should shrink from no problem when the time seems ripe for an attack upon it, and should not hesitate to press investigation, and ascertain the laws of even the most recondite problems of life and mind.

What we know is as nothing to that which remains to be known. This is sometimes said as a truism; sometimes it is half doubted. To me it seems the most literal truth, and that if we narrow our view to already half-conquered territory only, we shall be false to the men who won our freedom, and treasonable to the highest claims of science.

I must now return to the work of this section, from which I have apparently wandered rather far afield, further than is customary — perhaps further than is desirable. But I hold that occasionally a wide outlook is wholesome, and that without such occasional survey, the rigid attention to detail and minute scrutiny of every little fact, which are so entirely admirable and are so rightly here fostered, are apt to become unhealthily dull and monotonous. Our life-work is concerned with the rigid framework of facts, the skeleton or outline map of the universe: and, though it is well for us occasionally to remember that the texture and color and beauty which we habitually ignore are not therefore in the slightest degree non-existent, yet it is safest speedily to return to our base and continue the slow and laborious march with which we are familiar and which experience has justified. It is because I imagine that such systematic advance is now beginning to be possible in a fresh and unexpected direction that I have attempted to direct your attention to a subject which, if my prognostications are correct, may turn out to be one of special and peculiar interest to humanity.

AMONG THE PUBLISHERS.

RUFUS C. HARTRANFT, Philadelphia, has prepared a little book which he will publish under the title "Was Abraham Lincoln a Spiritualist?"

— D. C. Heath & Co., Boston, will issue this month Victor Hugo's "Hernani," edited by John E. Matzke, associate in Romance languages, Johns Hopkins University.

— Max O'Rell's new volume of travels, called "A Frenchman in America," will be published by the Cassell Publishing Company, New York, late in October. In this book he gives the humorous side of his experiences as a lecturer, and he has a good deal to say about the people whom he has met, both the interesting and uninteresting ones. Mr. E. W. Kemble has made over 135 illustrations for the book.

— Now that the time of year has arrived when, according to popular tradition, "oysters are in season," every lover of that choice sea-food should be provided with a copy of Professor William K. Brooks's book, "The Oyster: a Popular Summary of a Scientific Study," recently published by the Johns Hopkins Press of Baltimore. The book is intended for all who care for oysters, whether providers or consumers; oystermen, law-makers, or students. Of it President Gilman of the Johns Hopkins University says, in a brief note of introduction to the volume, "So well is the book written that many parts of it are as fascinating as a story."

— J. B. Lippincott Company will publish immediately: "Harmony of Ancient History and Chronology of the Egyptians and Jews," by Malcolm Macdonald; "The Natural History of Man and the Rise and Progress of Philosophy," a series of lectures delivered by Alexander Kinmont; and "Truth-Gleams," a series of essays on the controlling influences in life. Among the new publications to be issued late in the month are: "A Supplement to Allibone's Dictionary of Authors," in two volumes, by John Foster Kirk; "A Handbook of Industrial Organic Chemisty," by S. P. Sadtler, and "Atlantis Arisen; or, Talks of a Tourist about Oregon and Washington," by Mrs. Frances Fuller Victor.

— Those who have profited by the study of Verschoyle's "History of Ancient Civilization" will be gratified to learn that Messrs. D. Appleton & Co. are about to publish a volume which may be called a pendant or supplement of Verschoyle's work. This is "A History of Modern Civilization," a handbook based on Gustav Ducoudray's history. In this book "the author and adapter," according to a London critic, "have reached one of the rarest results in literary work, a summary at once comprehensive and readable."

— L. Reeve & Co., London, have in preparation a new work on the "British Fungi Phycomicetes and Ustilagineæ," by George Massee, lecturer on botany for the London Society for the Extension of University Teaching; a work on the British "Hemiptera Heteroptera," by Edward Saunders; a new work on the Lepidoptera of the British Islands," by Charles G. Barrett; and a new work on the "Physiology of the Invertebrata," by Dr. A. A. Griffiths.

— The *Chautauquan* for October has several illustrated articles and the portraits of a number of prominent women. Of the articles we note "Domestic and Social Life of the Colonists," I., by Edward Everett Hale; "Land Tenure in the United States," by D. McG. Means; "The History of Political Parties in America," by F. W. Hewes; "Physical Life," I., by Milton J. Greenman; "National Agencies for Scientific Research," by Major J. W. Powell; "Science, the Handmaid of Agriculture," by George William Hill; "Social Science in Society," by John Habberton; "The Bohemians in America," by Thomas Capek; and "The Citizenship of Crime," by Mrs. Kate Tannatt Woods.

— T. Y. Crowell & Co. have just ready, among other books, their new edition of Charles Dickens' complete works in fifteen and thirty volumes; "Making the Most of Life," by Rev. J. R. Miller, D.D.; "A Score of Famous Composers," by Nathan H. Dole; "Famous English Statesmen," by Mrs. Sarah K. Bolton; and the fourth volume of Sybel's "The Founding of the German Empire by William I."

— The present condition of the peasants in the Russian empire is the subject of a paper submitted by Vicomte Combes de Lestrade to the American Academy of Political and Social Science and published by the Academy. Every one remembers the enthusiasm which greeted the emancipation of the serfs by Alexander II. in 1861. The author of this monograph holds that he deserves credit for what he wished to do rather than for what he did. It is somewhat startling to be told by one who speaks from careful personal observation of the existing conditions that the authority of which the Seigneurs were stripped has only been transferred to the *mir*. This word and the system for which it stands are absolutely new to us. The author explains its organization and practical working, and recites the peculiar conditions under which the peasant is allowed to withdraw from the *mir* to which he belongs. The paper gives a sketch of the actual char-

Publications received at Editor's Office, Sept. 2–15.

HOWARD, C. R. The Transition-curve Field-Book. New York, Wiley. 109 p. 16°.
KINMONT, A. The Natural History of Man. Philadelphia, Lippincott. 335 p. 12°. $1.
NAVAL Progress, The Year's. Annual of the Office of Naval Intelligence; July, 1891. Washington, Government. 491 p. 8°.
RAILWAY Law and Legislation. A weekly magazine of information regarding laws, etc. Vol. I. No. 1. *w.* Washington, D. C., Canaday & West. 20 p. 8°. $3 per year.
SMITH, S. A. The Source and Nature of Electricity, and Its Application to the Electro-Plating Process. Providence, Gorham M'f'g Co. 35 p. 12°.
THURSTON, R. H. A Manual of the Steam-Engine. Part I. Structure and Theory. New York, Wiley. 871 p. 8°. $7.50.

acter of a Russian village, which touches the rest of the world only when the few Jewish traders come to it to take provisions in exchange for their wares. Each is the serf of all, and escape to the city, for reasons which are explained in the paper, offers no relief. At a time when the great empire is driving Jews from their homes, it will be of general interest to learn something of its own industrial and political unit ("Publication of the American Academy of Political and Social Science, No. 34." Station B, Philadelphia. 50 cents).

— The American Academy of Political and Social Science, with headquarters at Philadelphia, has issued in a little over a year over thirty papers in its regular publications, each dealing with some important topic in its field of investigation. Most of these have been of an historical or theoretical character. The last one which has appeared, however, is entirely practical in character, and will be of value to all who have occasion to use the statistical publications of any department of the United States government. The federal census, statistics of commerce, statistics of production, statistics of education, finance statistics, railroad statistics, and statistics of labor are discussed briefly in turn, and the work of the different bureaus which issue statistical publications of any description is in so far described. The author is William F. Willoughby of the Department of Labor ("Publications of the American Academy of Political and Social Science, No. 35." Station B, Philadelphia. 50 cents).

— According to the *Japanese Gazette*, printed in Yokohama, "during the month of June there were 5,575 persons who took books from the Tokyo Free Library, nearly all of them in the Japanese and Chinese languages. Among the 36,687 volumes drawn, 7,482 were books of history, biography, and geography, 6,753 of law and politics, 6,600 of literature and language, 5,877 of natural philosophy and medicine, 4,174 of engineering, the arts, and industries, 2,087 of philosophy and education, and the rest were of a miscellaneous kind."

SCIENCE

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[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

I have five vols. of "Olhausen's Biblical Commentary on the New Testament" that I would like to sell or exchange for works on geology of North America. These volumes are as good as new, except the slight fading of the black cloth covers. D. T. Marshall, Metuchen, N. J.

For sale or exchange, extra fine pair (♂ and ♀) of skins of Rocky Mountain Goat, with the skulls, etc., as needed for mounting; collection of vertebrate fossils from the Coup Fork Tertiary of Kansas; collection of works on descriptive cryptogamic botany—mostly on *Fungi;* thirteen vols. of *Botanical Gazette*, eight vols. *Grevillea*, four vols. *Notarisea;* stereopticon outfit, with attachment for microscopic projection; 148 stereopticon slides, illustrating zoology and cryptogams. Wanted—American and foreign works and pamphlets on Vertebrate Palæontology, and series of *Am. Jour. of Science* and other periodicals containing contributions to Vertebrate Palæontology. Prof. F. W. Cragin, Topeka, Kan.

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For Exchange.—A collector of twelve years' experience has many fine duplicate minerals which he would like to exchange for others. Address John Holl. Rollo, Wilmington, Del.

SCIENCE

NEW YORK, SEPTEMBER 25, 1891.

ANTHROPOLOGY PAST AND PRESENT.[1]

It was forty-four years ago that for the first and for the last time I was able to take an active part in the meetings of the British Association for the Advancement of Science. It was at Oxford, in 1847, when I read a paper on the "Relations of Bengali to the Aryan and Aboriginal Languages of India," which received the honor of being published in full in the "Transactions" of the association for that year. I have often regretted that absence from England and pressure of work have prevented me year after year from participating in the meetings of the association. But, being a citizen of two countries,— of Germany by birth, of England by adoption,— my long vacations have generally drawn me away to the Continent, so that, to my great regret, I found myself precluded from sharing either in your labors or in your delightful social gatherings.

I wonder whether any of those who were present at that brilliant meeting at Oxford in 1847 are present here to-day. I almost doubt it. Our president then was Sir Robert Inglis, who will always be known in the annals of English history as having been preferred to Sir Robert Peel as member of Parliament for the University of Oxford. Among other celebrities of the day I remember Sir Roderick Murchison, Sir David Brewster, Dean Buckland, Sir Charles Lyell, Professor Sedgwick, Professor Owen, and many more — a galaxy of stars, all set or setting. Young Mr. Ruskin acted as secretary to the geological section. Our section was then not even recognized as yet as a section. We ranked as a sub-section only of Section D, Zoology and Botany. We remained in that subordinate position till 1851, when we became Section E, under the name of Geography and Ethnology. From 1869, however, Ethnology seems almost to have disappeared again, being absorbed in Geography, and it was not till the year 1884 that we emerged once more as what we are to-day, Section H, or Anthropology.

In the year 1847 our sub-section was presided over by Professor Wilson, the famous Sanscrit scholar. The most active debaters, so far as I remember, were Dr. Prichard, Dr. Latham, and Mr. Crawfurd, well known then under the name of the Objector-General. I was invited to join the meeting by Bunsen, then Prussian Minister in London, who also brought with him his friend Dr. Karl Meyer, the Celtic scholar. Prince Albert was present at our debates, so was Prince Louis Lucien Bonaparte. Our ethnological sub-section was then most popular, and attracted very large audiences.

When looking once more through the debates carried on in our section in 1847, I was very much surprised when I saw how very like the questions which occupy us to-day are to those which we discussed in 1847. I do not mean to say that there has been no advance in our science. Far from it. The advance of linguistic, ethnological, anthropological, and biological studies, all of which claim a hearing in our section, has been most rapid. Still that advance has been steady and sustained; there has been no cataclysm, no deluge, no break in the advancement of our science, and nothing seems to me to prove its healthy growth more clearly than this uninterrupted continuity, which united the past with the present, and will, I hope, unite the present with the future.

No paper is in that respect more interesting to read than the address which Bunsen prepared for the meeting in 1847, and which you will find in the "Transactions" of that year. Its title is "On the Results of the recent Egyptian Researches in reference to Asiatic and African Ethnology, and the Classification of Languages." But you will find it a great deal more than what this title would lead you to expect.

There are passages in it which are truly prophetic, and which show that, if prophecy is possible anywhere, it is possible, nay, it ought to be possible, in the temple of science, and under the inspiring influence of knowledge and love of truth.

Allow me to dwell for a little while on this remarkable paper. It is true, we have travelled so fast that Bunsen seems almost to belong to ancient history. This very year is the hundredth anniversary of his birth, and this very day the centenary of his birth is being celebrated in several towns of Germany. In England also his memory should not be forgotten. No one, not being an Englishman by birth, could, I believe, have loved this country more warmly, and could have worked more heartily than Bunsen did to bring about that friendship between England and Germany which must forever remain the corner-stone of the peace of Europe, and the *sine quâ non* of that advancement of science to which our association is devoted. His house in Carlton Terrace was a true international academy, open to all who had something to say, something worth listening to, a kind of sanctuary against vulgarity in high places, a neutral ground where the best representatives of all countries were welcome and felt at home. But this also belongs to ancient history. And yet, when we read Bunsen's paper, delivered in 1847, it does not read like ancient history. It deals with the problems which are still in the foreground, and if it could be delivered again to-day by that genial representative of German learning, it would rouse the same interest, provoke the same applause, and possibly the same opposition also, which it roused nearly half a century ago. Let me give you a few instances of what I mean.

We must remember that Darwin's "Origin of Species" was published in 1859, his "Descent of Man" in 1871. But here in the year 1847 one of the burning questions which Bunsen discusses is the question of the possible descent of man from some unknown animal. He traces the history of that question back to Frederick the Great, and quotes his memorable answer to D'Alembert. Frederick the Great, you know, was not disturbed by any qualms of orthodoxy. "In my kingdom," he used to say, "everybody may save his soul according to his own fashion." But when D'Alembert wished him to make what he called the *salto mortale* from monkey to man, Frederick the Great protested. He saw what many have seen since, that there is no possible transition from reasonlessness to reason, and that with all the likeness of their bodily organs there is a barrier which no animal can clear, or which, at all events, no animal has as yet cleared. And what does Bunsen himself consider the real barrier between man and beast? "It is language," he says, "which is unattainable, or, at least, unattained, by any animal except man." In answer to the argument that, given only a sufficient number of years, a transition by imperceptible degrees from animal cries to articulate language is at least conceivable, he says: "Those who hold that opinion have never been able to show the possibility of the first step. They attempt to veil their inability by the easy but fruitless assumption of an infinite space of time, destined to explain the gradual development of animals into men; as if millions of years could supply the want of the agency necessary for the first movement, for the first step, in the line of progress. No numbers can effect a logical impossibility. How, indeed, could reason spring out of a state which is destitute of reason? How can speech, the expression of thought, develop itself, in a year, or in millions of years, out of articulate sounds, which express feelings of pleasure, pain, and appetite?"

He then appeals to Wilhelm von Humboldt, whom he truly calls the greatest and most acute anatomist of almost all human speech.

[1] Address before the section of Anthropology of the British Association for the Advancement of Science, at Cardiff, August, 1891, by Professor F. Max Müller, president of the section (Nature, Sept. 3).

Humboldt goes so far as to say: "Rather than assign to all languages a uniform and mechanical march that would lead them step by step from the grossest beginnings to their highest perfection, I should embrace the opinion of those who ascribe the origin of language to an immediate revelation of the Deity. They recognize at least that divine spark which shines through all idioms, even the most imperfect and the least cultivated."

Bunsen then sums up by saying: "To reproduce Monboddo's theory in our days, after Kant and his followers, is a sorry anachronism, and I therefore regret that so low a view should have been taken of the subject lately in an English work of much correct and comprehensive reflection and research respecting natural science." This remark refers, of course, to the "Vestiges of Creation" (see an article in the *Edinburgh Review*, July, 1845), which was then producing the same commotion which Darwin's "Origin of Species" produced in 1859.

Bunsen was by no means unaware that in the vocal expression of feelings, whether of joy or pain, and in the imitation of external sounds, animals are on a level with man. "I believe with Kant," he says, "that the formation of ideas or notions, embodied in words, presupposes the action of the senses and impressions made by outward objects on the mind. But," he adds, "what enables us to see the genus in the individual, the whole in the many, and to form a word by connecting a subject with a predicate, is the power of the mind, and of this the brute creation exhibits no trace."

You know how for a time, and chiefly owing to Darwin's predominating influence, every conceivable effort was made to reduce the distance which language places between man and beast, and to treat language as a vanishing line in the mental evolution of animal and man. It required some courage at times to stand up against the authority of Darwin, but at present all serious thinkers agree, I believe, with Bunsen, that no animal has developed what we mean by rational language, as distinct from mere utterances of pleasure or pain, from imitation of sounds and from communication by means of various signs, a subject that has lately been treated with great fulness by my learned friend Professor Romanes in his "Mental Evolution of Man." Still, if all true science is based on facts, the fact remains that no animal has ever formed what we mean by a language; and we are fully justified, therefore, in holding with Bunsen and Humboldt, as against Darwin and Professor Romanes, that there is a specific difference between the human animal and all other animals, and that that difference consists in language as the outward manifestation of what the Greeks meant by *Logos*.

Another question which occupies the attention of our leading anthropologists is the proper use to be made of the languages, customs, laws, and religious ideas of so-called savages. Some, as you know, look upon these modern savages as representing human nature in its most primitive state, while others treat them as representing the lowest degeneracy into which human nature may sink. Here, too, we have learned to distinguish. We know that certain races have had a very slow development, and may, therefore, have preserved some traces of those simple institutions which are supposed to be characteristic of primitive life. But we also know that other races have degenerated and are degenerating even now. If we hold that the human race forms but one species, we cannot, of course, admit that the ancestors even of the most savage tribes, say of the Australians, came into the world one day later than the ancestors of the Greeks, or that they passed through fewer evolutions than their more favored brethren. The whole of humanity would be of exactly the same age. But we know its history from a time only when it had probably passed already through many ups and downs. To suppose, therefore, that the modern savage is the nearest approach to primitive man would be against all the rules of reasoning. Because in some countries, and under stress of unfavorable influences, some human tribes have learned to feed on human flesh, it does not follow that our first ancestors were cannibals. And here, too, Bunsen's words have become so strikingly true that I may be allowed to quote them: "The savage is justly disclaimed as the prototype of natural, original man; for linguistic inquiry shows that the languages of savages are degraded and decaying fragments of nobler formations."

I know well that in unreservedly adopting Bunsen's opinion on this point also I run counter to the teaching of such well-known writers as Sir John Lubbock, Reclus, and others. It might be supposed that Mr. Herbert Spencer also looked upon savages as representing the primitive state of mankind. But if he ever did so, he certainly does so no longer, and there is nothing I admire so much in Mr. Herbert Spencer as this simple love of truth, which makes him confess openly whenever he has seen occasion to change his views. "What terms and what conceptions are truly primitive," he writes, "would be easy if we had an account of truly primitive men. But there are sundry reasons for suspecting that existing men of the lowest type forming social groups of the simplest kind do not exemplify men as they originally were. Probably most of them, if not all, had ancestors in a higher state" (*Open Court*, No. 205, p. 2896).

Most important also is a hint which Bunsen gives that the students of language should follow the same method which has been followed with so much success in geology; that they should begin with studying the modern strata of speech, and then apply the principles, discovered there, to the lower or less accessible strata. It is true that the same suggestion had been made by Leibnitz but many suggestions are made and are forgotten again, and the merit of rediscovering an old truth is often as great as the discovery of a new truth. This is what Bunsen said: "In order to arrive at the law which we are endeavoring to find (the law of the development of language) let us first assume, as geology does, that the same principles which we see working in the (recent) development were also at work at the very beginning, modified in degree and in form, but essentially the same in kind." We know how fruitful this suggestion has proved, and how much light an accurate study of modern languages and of spoken dialects has thrown on some of the darkest problems of the science of language. But fifty years ago it was Sanscrit only, or Hebrew, or Chinese, that seemed to deserve the attention of the students of comparative philology. Still more important is Bunsen's next remark, that language begins with the sentence, and that in the beginning each word was a sentence in itself. This view also has found strong supporters at a later time,— for instance, my friend Professor Sayce,— though at the time we are speaking of it was hardly thought of. I must here once more quote Bunsen's own words: "The supreme law of progress in all language shows itself to be the progress from the substantial isolated word, as an undeveloped expression of a whole sentence, towards such a construction of language as makes every single word subservient to the general idea of a sentence, and shapes, modifies, and dissolves it accordingly." And again: "Every sound in language must originally have been significative of something. The unity of sound (the syllable, pure or consonantized) must therefore originally have corresponded to a unity of conscious plastic thought, and every thought must have had a real or substantial object of perception. . . . Every single word implies necessarily a complete proposition, consisting of subject, predicate, and copula."

This is a most pregnant remark. It shows as clearly as daylight the enormous difference there is between the mere utterance of the sound *Pah* and *Mah*, as a cry of pleasure or distress, and the pronunciation of the same syllable as a sentence, when *Pah* and *Mah* are meant for "This is *Pah*," "This is *Mah*;" or, after a still more characteristic advance of the human intellect, "This is *a Pah*," "This is *a Mah*," which is not very far from saying, "This man belongs to the class or genus of fathers."

Equally important is Bunsen's categorical statement that everything in language must have been originally significant, that everything formal must originally have been substantial. You know what a bone of contention this has been of late between what is called the old school and the new school of comparative philology. The old school maintained that every word consisted of a root and of certain derivative suffixes, prefixes, and infixes. The modern school maintained that there existed neither roots by themselves nor suffixes, prefixes, and infixes by themselves, and that the theory of agglutination — of gluing suffixes to roots — was absurd. The old school looked upon these suffixes as originally independent and significative words; the modern school declined to accept this view except in a few irrefragable instances.

I think the more accurate reasoners are coming back to the opinion held by the old school, that all formal elements of language were originally substantial, and therefore significative; that they are the remnants of predicative or demonstrative words. It is true that we cannot always prove this as clearly as in the case of such words as *hard-ship*, *wis-dom*, *man-hood*, where *hood* can be traced back to *hâd*, which in Anglo-Saxon exists as an independent word, meaning state or quality. Nor do we often find that a suffix like *mente* in *claramente*, *claïrement*e, continues to exist by itself, as when we say in Spanish *clara, concisa y elegantemente*. It is perfectly true that the French, when they say that a hammer falls *lourdement*, or heavily, do not deliberately take the suffix *ment* — originally the Latin *mente*, "with a mind" — and glue it to their adjective *lourd*. Here the new school has done good service in showing the working of that instinct of analogy which is a most important element in the historical development of human speech. One compound was formed in which *mente* retained its own meaning; for instance, *forti mente*, "with a brave mind." But when this had come to mean *bravely*, and no more, the working of analogy began; and if *fortement*, from *fort*, could mean "bravely," then why not *lourdement*, from *lourd*, "heavily?" But in the end there is no escape from Bunsen's fundamental principle that everything in language was originally language — that is, was significative, was substantial, was material — before it became purely formal.

But it is not only with regard to these general problems that Bunsen has anticipated the verdict of our own time. Some of his answers to more special questions also show that he was right when many of his contemporaries, and even successors, were wrong. It has long been a question, for instance, whether the Armenian language belonged to the Iranic branch of the Aryan family, or whether it formed an independent branch, like Sanscrit, Persian, or Greek. Bunsen, in 1847, treated Armenian as a separate branch of Aryan speech; and that it is so was proved by Professor Hübschmann in 1883.

Again, there has been a long controversy whether the language of the Afghans belonged to the Indic or the Iranic branch. Dr. Trumpp tried to show that it belonged, by certain peculiarities, to the Indic or Sanscrit branch. Professor Darmsteter has proved but lately that it shares its most essential characteristics in common with Persian. Here, too, Bunsen guessed rightly — for I do not mean to say that it was more than a guess — when he stated that "Pushtu, the language of the Afghans, belongs to the Persian branch."

I hope you will forgive me for having detained you so long with a mere retrospect. I could not deny myself the satisfaction of paying this tribute of gratitude and respect to my departed friend Baron Bunsen. To have known him belongs to the most cherished recollections of my life. But though I am myself an old man,— much older than Bunsen was at our meeting in 1847,— do not suppose that I came here as a mere *laudator temporis acti*. Certainly not. If one tries to recall what anthropology was in 1847, and then considers what it is now, its progress seems most marvellous. I do not think so much of the new materials which have been collected from all parts of the world. These last fifty years have been an age of discovery in Africa, in central Asia, in America, in Polynesia, and in Australia, such as can hardly be matched in any previous century.

But what seems to me even more important than the mere increase of material is the new spirit in which anthropology has been studied during the last generation. I do not mean to depreciate the labors of the so-called *dilettanti*. After all, *dilettanti* are lovers of knowledge, and in a study such as the study of anthropology the labors of these volunteers, or *franc-tireurs*, have often proved most valuable. But the study of man in every part of the world has ceased to be a subject for curiosity only. It has been raised to the dignity, but also to the responsibility, of a real science, and it is now guided by principles as strict and as rigorous as any other science — such as zoology, botany, mineralogy, and all the rest. Many theories which were very popular fifty years ago are now completely exploded; nay, some of the very principles by which our science was then guided have been discarded. Let me give you one more instance — perhaps the most important one — as determining the right direction of anthropological studies.

At our meeting in 1847 it was taken for granted that the study of comparative philology would be in future the only safe foundation for the study of anthropology. Linguistic ethnology was a very favorite term used by Bunsen, Prichard, Latham, and others. It was, in fact, the chief purpose of Bunsen's paper to show that the whole of mankind could be classified according to language. I protested against this view at the time, and in 1854 I published my formal protest in a letter to Bunsen, "On the Turanian Languages." In a chapter called "Ethnology *versus* Phonology" I called, if not for a complete divorce, at least for a judicial separation between the study of philology and the study of ethnology. "Ethnological race," I said, "and phonological race are not commensurate, except in ante-historical times, or, perhaps, at the very dawn of history. With the migration of tribes, their wars, their colonies, their conquests and alliances, which, if we may judge from their effects, must have been much more violent in the ethnic than ever in the political periods of history, it is impossible to imagine that race and language should continue to run parallel. The physiologist should pursue his own science, unconcerned about language. Let him see how far the skulls, or the hair, or the color of the skin, of different tribes admits of classification; but to the sound of their words his ear should be as deaf as that of the ornithologist's to the notes of caged birds. If his Caucasian class includes nations or individuals speaking Aryan (Greek), Turanian (Turkish), and Semitic (Hebrew) languages, it is not his fault. His system must not be altered to suit another system. There is a better solution both for his difficulties and for those of the phonologist than mutual compromise. The phonologist should collect his evidence, arrange his classes, divide and combine as if no Blumenbach had ever looked at skulls, as if no Camper had ever measured facial angles, as if no Owen had ever examined the basis of a cranium. His evidence is the evidence of language, and nothing else; this he must follow, even though in the teeth of history, physical or political. . . . There ought to be no compromise between ethnological and phonological science. It is only by stating the glaring contradictions between the two that truth can be elicited."

At first my protest met with no response; nay, curiously enough, I have often been supposed to be the strongest advocate of the theory which I so fiercely attacked. Perhaps I was not entirely without blame, for, having once delivered my soul, I allowed myself occasionally the freedom to speak of the Aryan or the Semitic race, meaning thereby no more than the people, whoever and whatever they were, who spoke Aryan or Semitic languages. I wish we could distinguish in English as in Hebrew between *nations* and *languages*. Thus in the Book of Daniel, iii. 4, "the herald cried aloud, . . . O people, nations, and languages." Why then should we not distinguish between nations and languages? But to put an end to every possible misunderstanding, I declared at last that to speak of "an Aryan skull would be as great a monstrosity as to speak of a dolichocephalic language."

I do not mean to say that this old heresy, which went by the name of linguistic ethnology, is at present entirely extinct. But among all serious students, whether physiologists or philologists, it is by this time recognized that the divorce between ethnology and philology, granted if only for incompatibility of temper, has been productive of nothing but good.

Instead of attempting to classify mankind as a whole, students are now engaged in classing skulls, in classing hair, and teeth, and skin. Many solid results have been secured by these special researches; but, as yet, no two classifications, based on these characteristics, have been made to run parallel.

The most natural classification is, no doubt, that according to the color of the skin. This gives us a black, a brown, a yellow, a red, and a white race, with several subdivisions. This classification has often been despised as unscientific; but it may still turn out far more valuable than is at present supposed.

The next classification is that by the color of the eyes, as black, brown, hazel, gray, and blue. This subject also has attracted much attention of late, and, within certain limits, the results have proved very valuable.

The most favorite classification, however, has always been that according to the skulls. The skull, as the shell of the brain, has by many students been supposed to betray something of the spiritual essence of man; and who can doubt that the general features of the skull, if taken in large averages, do correspond to the general features of human character? We have only to look round to see men with heads like a cannon-ball and others with heads like a hawk. This distinction has formed the foundation for a more scientific classification into brachycephalic, dolichocephalic, and mesocephalic skulls. The proportion of 80:100 between the transverse and longitudinal diameter gives us the ordinary or mesocephalic type, the proportion of 75:100 the dolichocephalic, the proportion of 85:100 the brachycephalic type. The extremes are 70:100 and 90:100.

If we examine any large collection of skulls, we have not much difficulty in arranging them under these classes; but if, after we have done this, we look at the nationality of each skull, we find the most hopeless confusion. Pruner Bey, as Peschel tells us in his "Volkerkunde," has observed brachycephalic and dolichocephalic skulls in children born of the same mother; and if we consider how many women have been carried away into captivity by Mongolians in their inroads into China, India, and Germany, we cannot feel surprised if we find some longheads among the roundheads of those Central Asiatic hordes. Only we must not adopt the easy expedient of certain anthropologists who, when they find dolichocephalic and brachycephalic skulls in the same tomb, at once jump to the conclusion that they must have belonged to two different races. When, for instance, two dolichocephalic and three brachycephalic skulls were discovered in the same tomb at Alexanderpol, we were told at once that this proved nothing as to the simultaneous occurrence of different skulls in the same family: nay, that it proved the very contrary of what it might seem to prove. It was clear, we were assured, that the two dolichocephalic skulls belonged to Aryan chiefs and the three brachycephalic skulls to their non-Aryan slaves, who were killed and buried with their masters, according to a custom well known to Herodotus. This sounds very learned, but is it really quite straightforward?

Besides the general division of skulls into dolichocephalic, brachycephalic, and mesocephalic, other divisions have been undertaken, according to the height of the skull, and, again, according to the maxillary and the facial angles. This latter division gives us orthognathic, prognathic, and mesognathic skulls.

Lastly, according to the peculiar character of the hair, we may distinguish two great divisions, the people with woolly hair (Ulotriches) and people with smooth hair (Lissotriches). The former are subdivided into Lophocomi, people with tufts of hair, and Eriocomi, people with fleecy hair. The latter are divided into Euthycomi, straight-haired, and Euplocomi (not Euplocomic, wavy-haired, as Brinton gives it), wavy-haired. It has been shown that these peculiarities of the hair depend on the peculiar form of the hair-tubes, which, in cross-sections, are found to be either round or elongated in different ways.

Now all these classifications, to which several more might be added, those according to the orbits of the eyes, the outlines of the nose, the width of the pelvis, are by themselves extremely useful. But few of them only, if any, run strictly parallel. It has been said that all dolichocephalic races are prognathic, and have woolly hair. I doubt whether this is true without exception; but, even if it were, it would not allow us to draw any genealogical conclusions from it, because there are certainly many dolichocephalic people who are not woolly-haired, as, for instance, the Eskimos (Brinton's "Races and Peoples," p. 249).

Now, let us consider whether there can be any organic connection between the shape of the skull, the facial angle, the conformation of the hair, or the color of the skin, on one side, and what we call the great families of language on the other. That we speak at all may rightly be called a work of nature, *opera naturale*, as Dante said long ago; but that we speak thus or thus, *cosi o cosi*, that, as the same Dante said, depends on our pleasure — that is our work. To imagine, therefore, that as a matter of necessity, or as a matter of fact, dolichocephalic skulls have anything to do with Aryan, mesocephalic with Semitic, or brachycephalic with Turanian speech, is nothing but the wildest random thought; it can convey no rational meaning whatever. We might as well say that all painters are dolichocephalic, and all musicians brachycephalic, or that all lophocomic tribes work in gold, and all lissocomic tribes in silver.

If anything must be ascribed to prehistoric times, surely the differentiation of the human skull, the human hair, and the human skin, would have to be ascribed to that distant period. No one, I believe, has ever maintained that a mesocephalic skull was split or differentiated into a dolichocephalic and a brachycephalic variety in the bright sunshine of history.

But let us, for the sake of argument, assume that in prehistoric times all dolichocephalic people spoke Aryan, all mesocephalic, Semitic, all brachycephalic, Turanian languages; how would that help us?

So long as we know anything of the ancient Aryan, Semitic, and Turanian languages, we find foreign words in each of them. This proves a very close and historical contact between them. For instance, in Babylonian texts of 3000 B.C. there is the word *sindhu* for cloth made of vegetable fibres, linen. That can only be the Sanscrit *sindhu*, the Indus, or *saindhava*, what comes from the Indus. It would be the same word as the Homeric σινδών, fine cloth ("Physical Religion," p. 87). In Egyptian we find so many Semitic words that it is difficult to say whether they were borrowed or derived from a common source. I confess I am not convinced, but Egyptologists of high authority assure us that the names of several Aryan peoples, such as the Sicilians, and Sardinians, occur in the fourteenth century B.C., in the inscriptions of the time of Menephthah I. Again, as soon as we know anything of the Turanian languages — Finnish, for instance — we find them full of Aryan words. All this, it may be said, applies to a very recent period in the ancient history of humanity. Still, we have no access to earlier documents, and we may fairly say that this close contact which existed then existed, probably, at an earlier time also.

If, then, we have no reason to doubt that the ancestors of the people speaking Aryan, Semitic, and Turanian languages, lived in close proximity, would there not have been marriages between them so long as they lived in peace, and would they not have killed the men and carried off the women in time of war? What, then, would have been the effect of a marriage between a dolichocephalic mother and a brachycephalic father? The materials for studying this question of *metissage*, as the French call it, are too scanty as yet to enable us to speak with confidence. But whether the paternal or maternal type prevailed, or whether their union gave rise to a new permanent variety, still it stands to reason that the children of a dolichocephalic captive woman might be found, after fifty or sixty years, speaking the language of the brachycephalic conquerors.

(To be continued.)

NOTES AND NEWS.

FROM an experiment reported in Bulletin No. 35 of the Kentucky Experiment Station, which is located in the heart of the Blue Grass region at Lexington, it appears that the results are the same as they have been for the last two seasons, that fertilizers, whether used in combination or singly, have no effect upon the yield of wheat. On the same lands, for corn, potatoes, hemp, and tobacco, the results of potash fertilizers show very favorably.

— Sr. H. Morize, astronomer at the observatory of Rio de Janeiro, has just published a "Sketch of the Climatology of Brazil," which will be welcome to meteorologists, as hitherto systematic observations have only been published for a very few points of that immense country, covering 39 degrees of latitude. The sketch has been drawn up mainly from the observations of travellers and private observers. *Nature* extracts a few brief notes from the sketch, as follows. Thunder-storms are very frequent all along the coast, and are mostly harmless; regular cyclones are very rare. The most dangerous winds are the pamperos, which blow from the south-west, and have been fully described by the late Admiral Fitz-Roy, and a still more rare and dangerous wind which blows from the south-east. As regards temperature, the author has divided the country into three zones, and some valuable data are given for various localities. Parts of the country are subject to prolonged drought; it is said that at Pernambuco no rain fell during the whole year 1792, and a third of the population died from its effects; droughts have recurred during the present century with some regularity, the last being in the year 1888–89. The most complete series of observations is that for Rio de Janeiro, which dates from 1781, with occasional interruptions. The highest shade temperature was 99.5° in November, 1883, and the lowest 50.4° in September, 1882. There are also good series of observations for Rio Grande do Sul and São Paulo.

—A recent calf-feeding experiment made at the Iowa Agricultural Experiment Station seems to indicate that (1) a ration of skim milk and ground flaxseed compares favorably with a new-milk ration for young calves; (2) the larger gain came from the whole milk, but a part of it was partly due to the individuality of the calves, and good results and thrifty growth were made on skim milk and ground flaxseed; (3) the skim-milk calves were interrupted less in their growth by weaning than the whole milk calves; (4) a saving in value of butter fat alone of $1.11 per month on each calf was effected by substituting the ground flaxseed; and (5) the cost of producing a pound of gain was 7.6 cents for the fresh-milk ration and 5 cents for the skim-milk ration.

— According to *Nature*, M. Lancaster has recently indicated in *Ciel et Terre* the divergences from normal temperature in Europe in the five years 1886–90. It appears (and is shown in a map) that the centre of the "island of cold" lies over the north of France, the south of Belgium, and the most western parts of Germany. From this centre the cold decreases pretty regularly outwards on all sides to a nearly circular line of *nil* divergence, which, embracing the whole of Great Britain, crosses the south of Sweden, then goes along the German-Russian frontier, through Hungary, the south of Italy, the north of Africa, and across Spain. Throughout this inclosed region abnormally low temperatures have prevailed. Siberia, too, shows thermal depression, which M. Lancaster thinks may be connected with that in western Europe.

— In *Nature Notes* for August, Mr. R. T. Lewis, on the authority of a correspondent in whose trustworthiness he has entire confidence, gives a curious account of the appreciation with which the song of the cicada is heard by insects other than those of its own genus. The correspondent has frequently observed in Natal, says *Nature*, that when the cicada is singing at its loudest, in the hottest portion of the day, it is attended by a number of other insects with lovely, gauze-like, irridescent wings, whose demeanor has left no doubt on his mind that the music is the attraction. The cicada, when singing, usually stations itself upon the trunk of a tree with its head uppermost, and the insects in question, to the number sometimes of fifteen or sixteen, form themselves into a rough semicircle at a short distance around its head. During a performance one of the insects was observed occasionally to approach the cicada and to touch it upon its front leg or antennæ, which proceeding was resented by a vigorous stroke of the foot by the cicada, without, however, any cessation of its song. The insects composing the audience are extremely active; and so wary that they take flight at the least alarm on the too near approach of any intruder. Some of them, however, have been captured; and on examination these "proved to belong to the same family as the most beautiful of British insects, the lace-wing fly, which, indeed, they closely resemble except as to size, their measurement across the expanded wings being a little over two inches. They have since been identified by Mr. Kirby at the British Museum as *Nothochrysa gigantea*."

— An experiment to test the effect of feed on the quality of milk, recently made at the Iowa Experiment Station, indicates that: (1) quality of milk, so far as measured by its percentage of fat, was changed by feed to a much greater degree than was quantity. Two-thirds of the increase in average gross yield of butter fat was due to improved quality of the milk, and only one-third to increased milk flow. (2) Sugar meal produced .58 of a pound more butter fat per 100 pounds of milk than did corn and cob meal; this difference is seventeen per cent of the amount of fat in 100 pounds of milk produced by corn and cob meal. (3) Sugar meal produced .73 of a pound more total solids per 100 pounds of milk than did corn and cob meal; this difference is six per cent of the solids in 100 pounds of milk produced by corn and cob meal. (4) As compared with corn and cob meal, sugar meal increased the ratio of fat to "solids not fat" in 100 pounds of milk, from 396 per 1,000 of "solids not fat," to 457 per 1,000 of "solids not fat" an increase of over fifteen per cent.

— Under the heading "Breeding of Orchard and Garden Fruits" attention is directed in a recent bulletin of the Iowa Agricultural Experiment Station to the following well supported facts: (1) In the States west of Lake Michigan no important advances have been made in the great work of adapting fruits to the peculiar climate and soil of Iowa by growing seedlings from the variety introduced from south-western Europe, nor from their seedlings originating in the Eastern or Southern States. (2) Valuable seedlings of the orchard and garden fruits have come from the varieties introduced from eastern Europe or northern Asia, and from native species. (3) Methodic crossing and hybridizing have given in the past, and promise to give in the near future, more valuable and certain results than can be hoped for from chance breeding from intermingled varieties and species.

— We learn from the Tiflis paper *Caucasus*, says *Nature*, that during an excursion to the sources of the Jiagdon, which was made recently by several explorers, no fewer than eight glaciers were discovered, six of which are not marked on the five-versts-to-the-inch map of Caucasus. They have been viewed now and sketched from Styr-khokh Pass. The southern slope of the branch-ridge of the main chain, between the Kazbek and the Syrkhubarzon peak, has also been sketched from the Trussoff's Pass, and it appears that several of the glaciers of this part of the chain are not represented on the great map, while perpetual snow is shown where there is none. The glaciers visited by the party proved to have very much changed their aspect since 1882. Several sulphur and iron carbonate springs were visited in the Trussoff's valley, and several interesting Alpine flowers in bloom were collected on the passes.

— It is well known that the fox possesses an excellent "head for country." Referring to this subject in [illegible] in the current number o[illegible] and [illegible] Harting says a fox has b[illegible] to return [illegible] "earth," and this not [illegible] Yorkshire, and sent into [illegible] to be [illegible] of the late Mr. Fitzherber[illegible] of Claughton [illegible] and his identity was esta[illegible] ear by the fox-catcher. [illegible] Mr. Harting [illegible] friend Captain F. H. Salvi[illegible] time, and was well acqu[illegible] with Mr. [illegible] him all the details.

— The following are some results of Herren Elster and Geitel's recent electric observations on the Sonnblick, described to the Vienna Academy, and noted in *Nature* of Sept. 10: The intensity of the most refrangible solar rays, measured by their discharging effect on a negatively electrified surface of amalgamated zinc, is about doubled on rising 3,100 metres from the lowland. The authors were unable to find other actino-electrically active substances; even pure fresh snow and dry Sonnblick rock were not perceptibly discharged by light. Waterfalls may produce in a valley a negative fall of potential, and to considerable heights (500 metres). The morning maximum in fall of potential, observed regularly between 7 and 9 A.M. in the plain and in Alpine valleys, was absent at 3,100 metres. Before thunder-storms in July, the positive fall of potential sank gradually, in light showers, to *nil*, at which it remained sometimes two or three hours till completion of the electrical process in the cloud. In thunder-clouds, or on low ground, during a thunder-storm, the atmospheric electricity usually changes sign after a discharge. St. Elmo's fire (negative as often as positive) always accompanied thunder-storms. The observation that negative St. Elmo's fire burns with blue flame, positive with red, was repeatedly confirmed.

— Professor Erwin H. Barbour, formerly of Iowa College, Grinnell, Io., has been elected to the chair of geology at the University of Nebraska, Lincoln, Neb.

SCIENCE:

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

ELECTRO-HORTICULTURE.

IN the winter of 1889–90 experiments were undertaken at the Cornell University Experiment Station, by Professor L. H. Bailey, to determine what influence the ordinary street electric light exerts upon plants in greenhouses. [illegible] has been said among gardeners [illegible] retarding or accelerating influences [illegible] plants. Many have supposed that the electric light can be introduced profitably into greenhouses for the purpose of hastening growth. Still others have supposed the electric lights at exhibition halls to be injurious to plants, and [illegible] that flowers fade quickly when placed near them. The [illegible] ght to vegetation should be understood, [illegible] thought of introducing the light [illegible] upon plants, both under [illegible] which demands careful investigation.

In recapitulating the results of the experiments made, Professor Bailey says, in Bulletin 30 of the station, that it is impossible to draw many definite conclusions from the researches made. The many conflicting and indefinite results indicate that the problems vary widely under different conditions and with different plants. Yet there are a few points which are clear: the electric light promotes assimilation, it often hastens growth and maturity, it is capable of producing natural flavors and colors in fruits, it often intensifies colors of flowers and sometimes increases the production of flowers. The experiments show that periods of darkness are not necessary to the growth and development of plants. There is every reason, therefore, to suppose that the electric light can be profitably used in the growing of plants. It is only necessary to overcome the difficulties, the chief of which are the injurious influences upon plants near the light, the too rapid hastening of maturity in some species, and, in short, the whole series of practical adjustments of conditions to individual circumstances. Thus far, to be sure, more of the injurious effects than of the beneficial ones have been learned, but this only means that definite facts concerning the whole influence of electric light upon vegetation are being acquired; and in some cases the light has already been found to be a useful adjunct to forcing establishments.

The experiments suggest many physiological speculations, three of which may be mentioned. It is a common notion that plants need rest at night, but this is not true, in the sense in which animals need rest. Plants have simply adapted themselves to the conditions of alternating daylight and darkness, and during the day they assimilate or make their food, and during the night, when, perforce, assimilation must cease, they use the food in growth. They simply practice an individual division of labor. There is no inherent reason why plants cannot grow in full light, and, in fact, it is well known that they do grow then, although the greater part of growth is usually performed at night. If light is continuous, they simply grow more or less continuously, as conditions require, as they do in the long days of the arctic regions, or as the plants experimented with did under continuous light. There is no such thing as a plant becoming worn out or tired out because of the stimulating influence of continuous light.

It would seem, therefore, that if the electric light enables plants to assimilate during the night, and does not interfere with growth, it must produce plants of great size and marked precocity. But there are other conditions, not yet understood, which must be studied. The radish plants, and many others, were earlier but smaller under the influence of the light. Observation and chemical examination showed that a greater degree of maturity had been attained. Perhaps they assimilated too rapidly; perhaps the functions of the plant had been completed before it had had time to make its accustomed growth. Perhaps the highly refrangible and invisible rays from the electric lamp have something to do with it. In fact, this latter presumption probably accounts for much, if not all, of the injury resulting from the use of the naked light, for the effect of the interposition of a clear pane of glass is probably to absorb or obstruct these rays of high refrangibility. Good results which follow the use of a globe or a pane of glass show, on the other hand, that the injury to plants cannot result from any gases arising from the lamp itself, as has been supposed by some observers. In the experiments there was no perceptible odor from the gases of combustion; and it may also be said that commercial forcing-houses are not tight enough to hold sufficient quantities of these gases to injure plants.

It is highly probable that there are certain times in the life of the plant when the electric light will prove to be particularly helpful. Many experiments show that injury follows its use at that critical time when the plantlet is losing its support from the seed and is beginning to shift for itself, and other experiments show that good results follow its later use.

HEALTH MATTERS.

Physiology of the Gastric Glands.

ACCORDING to Heidenheim, the delomorphous or parietal cells of the gastric glands — that is, the glands of the fundus — secrete or elaborate the hydrochloric acid of the gastric juice, while the adelomorphous or central cells secrete the pepsin (*British Med. Jour.*). One of the chief arguments advanced in favor of this view rests on the experiments of Swiecicki, who asserted that in the œsophageal glands of the frog pepsin alone is formed, while only hydrochloric acid is formed in the stomach. Fränkel has submitted the statements of Swiecicki to a renewed test. He prepared the mucous membrane of (1) the œsophagus, and (2) the fundus of the stomach of ten frogs, and extracted each separately in two litres of water. To eighteen centimetres of the watery extract of each there were added two centimetres of a one per cent dilution of hydrochloric acid, and a small piece of fibrine. Both mixtures were kept at 37° C. for twenty-four hours; both extracts digested the fibrine. It would seem, therefore, that both the œsophagus and stomach of the frog contain pepsin, or rather, pepsinogen. This would tend to show that in the frog the delomorphous cells secrete both pepsin and acid, for fibrine is digested in the stomach when the secretion from the œsophagus is prevented from entering that organ. Fränkel found that the mucous membrane both of the stomach and œsophagus produced a mineral acid, for both gave the phloro-glucin-vanillin reaction. Contejean finds that section of the vagi does not interfere with gastric digestion in the frog. Electrical stimulation of the peripheral end of the vagus, or of the central ends of the vagus or glosso-pharyngeal, causes a copious secretion of mucus. In the last case there is no secretion of mucus when the vagi are divided. Perhaps the result is due to a reflex secretion, the reflex centre being in the bulb, while the vagus is the efferent channel for the impulses affecting the secretory glands. In birds also it would appear that the vagus influences the secretion of gastric juice. Oxenfeld finds that in birds (pigeons) stimulation of the peripheral end of the vagus is followed by a copious secretion of acid gastric juice. At the same time the stomach is forcibly contracted, and it might be assumed that the increased quantity of gastric juice was simply forced out of the glands by the concentration of the musculature of the stomach. Oxenfeld, however, is of opinion that this is not the true explanation, and he assumes that the vagus contains secretory fibres for the gastric glands.

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.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

How Children Learn to Talk.—A Study in the Development of Language.—Children's Vocabularies.

PHILOLOGISTS and others interested in the origin of language and the development of intellect find very striking analogies between the development of speech and intelligence in the race and in the child, and have obtained some very valuable hints as to the laws determining the growth of language. Scientific psychologists and educators have also gained many important truths from the study of children. A much more extensive and detailed study, however, is now necessary to further progress in either line.

The first thing to be done in every scientific investigation is to collect a large number of reliable facts, from which generalizations may be made and theories found that will guide the investigator in further researches, and lead to the discovery and unification of a general law of nature that can usually be turned to practical account by the inventor, educator, or legislator. Facts of every kind in regard to development of intelligence in children and their progress in language are important, and in the earlier stages of the investigation the common and ordinary facts rather than the unusual and extraordinary are the most valuable. For the purpose of securing such facts and arousing interest in the study of children I wrote an article some months ago entitled "Children as Teachers," and published it in a number of papers. The records sent me in response to the request in that article are very interesting and suggestive. Many interested in the subject, however, doubtless overestimated the difficulty of securing valuable records, and therefore I have not yet received a sufficient number of records to justify me in making a full report, as I had promised, at present. The records so far examined serve to bring out the great individual differences in children rather than to show what is common to all, yet they are common characteristics suggestive of general laws sufficient to confirm me in the belief that a comparison of a number of such records will give very valuable results.

A convenient method for those who cannot keep a daily record of a child's progress in language was adopted by some reporting to me. During a certain period special attention was paid to the child's language, and all words the child was known to use understandingly were noted down in alphabetical order (the child's pronunciation of the words being indicated as nearly as possible), and this was taken as the child's vocabulary at that age. A few months later the process was repeated, and the progress that had been made could then readily be seen by comparing the two records.

The number of words used by children two years old differs considerably, but is usually larger than parents supposed. The number varies from a very few words for the child who is backward in learning to talk, though perhaps not less intelligent otherwise, up to a thousand words for children more precocious in that particular. Judging from the records in my possession, from two to four hundred words is the more common number.

The rate at which new words are acquired varies greatly for different children and at different ages. After they are once fairly started in learning language, it is usually quite rapid, especially with those who are late in beginning to talk. For children just past two years of age, from sixty to one hundred words per month seems to be a common number. If new words should continue to be acquired at this rate until maturity, as they probably are by those who study and read much, an adult would have a vocabulary of from 15,000 to 25,000 words (see "Size of an Ordinary Vocabulary," *Science*, Aug. 21, 1891). The additional words used by a child do not represent all of his progress in language. He may have learned the meaning of many words he has had no occasion to use; he may have learned something about forming plurals and the different parts of verbs, and considerable about how to put words together in sentences. The progress in the latter respect may be shown by keeping a record of his characteristic attempts at sentence making, being careful to omit sentences that are evidently repeated from memory.

The part of speech most used by children seems to be the noun. About 60 per cent of the words in the English language are nouns, 22 per cent adjectives, 11 per cent verbs, and 5½ per cent adverbs, while conjunctions, prepositions, and pronouns form but an insignificant portion of the whole. In an ordinary vocabulary, taking "Robinson Crusoe" as the standard, the proportion of nouns is smaller, and in a still smaller vocabulary there seems to be occasion for the use of a greater variety of verbs than nouns, and a necessity for the use of a number of prepositions, pronouns, and conjunctions. On a page of "Robinson Crusoe" containing 215 different words, but 24 per cent were nouns. Hence the fact that in a child's vocabulary of a few hundred words from 55 to 85 per cent of them are nouns, while but few of the prepositions, pronouns, and conjunctions that it hears repeated so frequently are used, is quite significant. Nouns, however, are not always learned easier and earlier than other parts of speech, for such a verb as "come," or adjective as "hot," may be among the first words learned. Any word which can be associated with a distinct, sensible experience can readily be learned, but abstract terms are not found in children's vocabularies.

General terms are used by children, at quite an early age, with some degree of correctness, though of course all that is connotated or included under a general term is not understood by any one until its scientific meaning is known. A general term is applied to all individuals having certain characteristics, though they may differ in other respects. The accuracy with which a child uses general terms depends upon the distinctness of his ideas of the special characteristics to which the term is applied, and his power of noting and discriminating those special qualities among a variety of others. His attainments in these two respects are limited by his previous experience. A child who calls a goat a "dog" may lack in clearness of conception of the characteristics of dogs, or in his powers of discrimination, or only in experience. In the latter case he classifies it with the group of animals it resembles more closely than any others with which he is acquainted. A child of twenty-six months who found a small crab in her oyster soup classified it at once with the group of animals it seemed to her to most resemble, and called it a "bug," then performing a considerable act of inference, she gave it the more definite name "oyster-bug." A little girl of less than eighteen months, who learned the word "cut" in connection with the use of a knife, not only called all knives "cutie," but applied the same term to shears when she saw the same operation performed with them, and later to a sickle with which grass was being cut. Nothing is more interesting or important in the study of children than the way in which they generalize, classify, and infer, and instances of such childish judgments and inferences, so odd to us, yet really so natural and logical from their point of view, should be carefully noted and recorded.

Children sometimes form a language of their own entirely different from that of their parents. This is more likely to occur with children of the same age, especially if they are alone together much. Instances are known of children forming apparently quite complete vocabularies, and using no other for several years. This tendency to originate language is shown in almost every child by the invention of new words or new uses for words. New terms are often formed by imitating the noise made by the animal or thing named, as "bow-wow" for dog, "choo-choo" for locomotive, and sometimes by the repetition of a sound made in performing an act, or an emotional sound made at sight of a new object or act. Any sound thus associated with an object, act, quality, or state of feeling may be used by the child as a word, and, if the parents or playmates accept it as having a certain significance, it becomes fixed as a permanent part of the child's vocabulary.

Baby talk, or the peculiar pronunciation used by children, and frequently imitated in literature, is a subject of considerable interest. How much of what is given as "baby talk" has really been originated by children? How much of the incorrect pronunciation of any particular child is due to his inability to pronounce correctly, and how much to the foolish habit of mispronouncing words when speaking to children practised by so many fond parents? Of still more importance is it to know whether there really is any general law of mispronunciation that may be of practical value to the educator. In only a part of the records sent me was the pronunciation used by the child indicated, hence only the probabilities in regard to the law can be given. In the first place, it must be understood that the ability to pronounce words is entirely independent of the ability to understand their meaning, and either capacity may be developed in advance of the other. However, in the acquirement of new words, difficulty of pronunciation may exercise some influence in preventing the adoption of certain words into the vocabulary. Not all children are influenced in this way; some adopt difficult words but use a sound easily pronounced in place of the one they cannot pronounce, sometimes following a regular system of substitution. The law of mispronunciation proposed by Noble (*Education*, 1888) seems theoretically quite probable, and some of the facts support it, but not enough have been collected to establish it. He reasons that correct pronunciation depends upon clear perception of the sounds to be uttered and a knowledge of the motions necessary to produce them. The knowledge of the proper movements to be made are partly gained by watching the motions made by others in speaking. On imitating the sound the errors in movement are detected and corrected by comparing the resulting sound with the sound heard. The sounds then that are most distinctly pronounced and requiring movements that are the most clearly visible will naturally first be learned and be most clearly pronounced. Those made in the front part of the mouth, such as labials and dentals, fulfil both of these conditions, while those made in the back part of the mouth usually fulfil neither of them. This law, if approximately true, must yet be modified by the fact that children can usually make every one of the elementary sounds used in language before they begin to talk. The difficulty in pronouncing a word is not to utter the elementary sounds of which it is composed, but to properly combine them. As in learning other complex series of motions, it is not a question of making any one motion, but of properly co-ordinating a series of simple motions. No one has any difficulty in pronouncing such words as "three," and "gray," and "geese" separately, but many do in pronouncing them rapidly one after the other. For a similar reason a child who can pronounce perfectly a sound in one word is wholly unable to utter it in another. Besides this, sounds are modified somewhat by the sounds that precede and follow them. Almost every one also slurs some sounds in his pronunciation, and children frequently notice and try to imitate only the most distinctly pronounced sounds. They therefore often mispronounce, not from inability to utter the sounds, but because they have failed to notice some of the less perfectly pronounced ones. Since sounds made at the beginning of words are least modified by other sounds, mispronunciation can best be studied in the initial sounds of words. The letter with which a word begins usually, but not always, indicates the sound. The following is the order for the letters appearing most frequently as initial letters in children's vocabularies: s, b, c, p, t, w, d, m, h, f, r, l, g, n. To understand the significance of this, it must be compared with the order of frequency for the difficult letters in the dictionary (s, p, c, a, t, b, r, m, d, f, e, h, l, g), and in "Robinson Crusoe" (s, c, p, a, f, b, r, m, e, t, w, h, l, i, g). One of the most marked differences is the greater number of words beginning with the dentals *b* and *d* to be found in the vocabularies of children.

Many very interesting questions were suggested by the study of the records already sent me, but a much larger number of vocabularies must be compared before reliable answers can be obtained. I shall be glad to receive such records at any time, or to communicate with any one in regard to methods of carrying on the study of children. Letters directed to Rhodes, Iowa, will always reach me.

E. A. KIRKPATRICK.

Rhodes, Io., Sept. 14.

The Convection Theory of Storms.

DR. HANN of Vienna has published recently an extended discussion of this subject, and one which has the extremest significance (Sitzber. d. kais. Akad. d. Wissensch. in Wien, April, 1891). He reiterates his view that in our storms at heights of 10,000 feet there is a fall in temperature, and a corresponding rise in our high areas. These points have been sufficiently answered already (*Science*, Vol. XVI., p. 136). The remaining discussion merits our attention, as it presents a rather strong attack upon the theories ordinarily accepted. A free translation of the argument is here given. Dr. Hann says:

"How can we think that such extremely flat disks as the great storms of the higher latitudes are can maintain themselves and advance through a rising of air particles. Our whirls have often more than a hundred times greater extension horizontally than vertically. Doberck gives this ratio as 250:1. A chimney, as is well known, draws only when its height is many times greater than its interior diameter. But in our whirls the relation is in a most extreme manner opposite. How such an exceedingly flat air-disk, only through an interior force, that is, through a freeing of latent heat by a local interior moisture condensation, can move itself in the atmosphere, appears to me difficult to understand. The whole height of the atmosphere (so far as it can come into consideration for the condensation theory) at the utmost is small as compared to the horizontal diameter of our whirl (above 25,000 feet is there no moisture). I do not know that the convection theory has seriously considered this objection. This objection does not hold against the theory that correlates the whirl with disturbances in the general circulation currents of the atmosphere.

"A fact which stands out in sharp contradiction with the plain convection theory of our storms lies in the yearly period of their frequency and intensity. If the convection theory is clearly applicable to most of our storms, how can it be that these storms have their greatest intensity and frequency in the winter, even at a time of the year when the conditions, as well for their origin as for their continuance, are most unfavorable?

"In winter the moisture of the air is slight and the thermic equilibrium most stable. Upon the continents the lowest layers are often for a long time the coldest, and the temperature increases above. The heat diminution with height is very small in winter, even less than in a rising air current due to the distribution of moisture. How can a whirl under such conditions of the convection theory reach to the interior of Siberia, where the temperatures are −22° F. to −40° F., and there is no moisture. It is an inevitable consequence of the convection theory that the cyclones of the summer must reach their greatest intensity and frequency, because at this time the moisture of the air is greatest, the heating of the lowest layers the most active, and the heat diminution with height in consequence the most rapid.

"In fact, heat thunder-storms and tropical cyclones, the appearances to which rightly the convection theory can find application, are limited to the warm season. Tropical cyclones reach a maximum of occurrence at a time when the temperature of the sea is highest, or when a generally uniform air pressure and the absence of strong air currents favor largely the development as well as the advance of such whirls, which, perhaps, have for the great part their driving force in themselves. Also the heat thunder-storms or thunder-storm whirls of our summers occur most abundantly and most intensely, with uniform air pressure, weak winds, a strong heating of the lower air strata, and a high humidity of the air.

"The storms of the temperate latitudes have, moreover, still another peculiarity, outside of their maximum action in the coldest season during a period of the greatest stability in the thermic equilibrium of the atmosphere, which stands in contradiction to the convection theory, namely, a tendency to take the same path one after the other. Upon this peculiarity Köppen has remarked before (Met. Zeit., 1874, Vol. IX., p. 380), and we need only to examine the daily weather charts to find clear examples in abundance.

"This view is wholly contrary to the facts which the true cyclones of the convection theory show, and must show. A cyclone equalizes the temperature above and below in the region through which it passes. The condensation process heats the higher layers, cools off the lower, and makes a more stable equilibrium in the atmosphere. At the same time the moisture of the lower air layers is used up, and at the same place precipitation cannot occur again through pure convection currents. The cyclones of the convection theory must diminish or become extinct, if placed where shortly before another cyclone was in activity which has disposed of the latent energy stored up in the lower layers of the atmosphere in the form of high temperature and great moisture.

"The heat thunder-storms of our summers do not show this peculiarity, and are appearances to which the pure convection theory can find full application. On the other hand, the fact that the cyclones of our latitudes often follow a path behind each other, shows that the convection theory has no application, or only a subordinate one, and that the force upon which their origin and advance depend most importantly is not in themselves, but must be sought outside. We must refer to the conditions of the general distribution of pressure and currents of the general atmospheric circulation for their origin and development.

"If we correlate the origin and forward movement of the cyclones of the temperate and high latitudes with the general circulation of the atmosphere, then the greater frequency and intensity in winter explains itself wholly, as well as all the peculiarities which the application of the pure convection theory contradicts. That also in whirls of this origin the condensation of moisture plays a greater or less secondary *rôle* no physicist can well doubt."

This is a most significant utterance and important attack upon the convection theory. Heretofore this theory has been assailed in England and this country from outside, but now the attack is from within the camp and by one of the foremost of its former defenders. The arguments, to be sure, are rather old, but they are put in a fresh dress. We welcome Dr. Hann to our side of the controversy. It should be noted that, as Miss Clerke has said, the original convection theory has been so added to and corrected it can hardly be recognized. Dr. Hann takes up only one view, and the one applicable to the summer season; but there is another view which applies to the winter, namely, that an unstable equilibrium in the atmosphere may occur whenever, through any reason, a central core becomes heated above its surroundings. This gives a less diminution of temperature with height, instead of greater, as in the other view, and at the same time causes a rising tendency in the air; this has been called the "balloon" effect. Dr. Hann will find that the "chimney" effect has been relegated to the tornado, in which the height is very much greater than the breadth.

There would seem to be no greater difficulty in accounting for the moisture and generation of a storm which follows another than in accounting for these conditions in the first. It is not supposed that a storm carries away very much from any region, but each one may feed upon the conditions which surround it. In fact, there is probably a good deal more moisture in sight and usable after a storm has passed than before, unless the first storm is followed directly by a high area, which is contrary to Dr. Hann's supposition. It does not seem as though these and other more serious objections to the old theory can longer be ignored by convectionists. H. A. HAZEN.

Washington, D.C., Sept. 21.

BOOK-REVIEWS.

A Girl in the Karpathians. By MENIE MURIEL DOWIE. New York, Cassell. 8°. $1.50.

THAT this is an entertainingly written book of travel few will deny. The region described is one visited little, or we might say not at all, by the ordinary tourist, and the author abandoned herself to a life with the natives for the several months she was in the Karpathians.

That there are many girls like Ménie Muriel Dowie may well be doubted, and perhaps it is as well that there are not. She is certainly bright, but independent almost to a fault. In answer to those asking why she went alone, she writes: "I gaze at their indulgent, smiling eyes, and their self-satisfied faces, and I dare not tell them that I do it from sheer bold preference. I couldn't have the heart to wound and shock them so, and I say, what is perhaps also true, that I am driven to it, for nobody cares to come to the places I care to go to." That there must be a little of self-satisfaction in Miss Dowie's face, one cannot help thinking. There must be some self-reliance at least in a girl of twenty-five, as the author describes herself, who, armed with a revolver and dressed in knickerbockers, plunges into a thinly-settled region for a sojourn of months. She hails from Scotland, but a love for cigarettes does not at all conform with the general conception of a Scottish lassie's character.

But eccentricities can be overlooked in one as clever as Ménie Muriel Dowie, and the interest in her personality adds to the charm of her book. She shows her youth occasionally in the earnestness of her self-communing over the problems of life, but her account of the people she lived with is well worth reading. To be sure she tells us inadvertently that it is the way of returning travellers to swap lies, but the book shows little sign of its being a work of fiction.

AMONG THE PUBLISHERS.

THE next volume of the Contemporary Science Series, published by Chas. Scribner's Sons, will be "The Man of Genius," by Professor Lombroso. This volume, which will be issued on September 25, will be copiously illustrated.

— Messrs. Smith, Elder, & Co. have in preparation "Vertebrate Embryology," by A. Milnes Marshall, F.R.S., professor in the Victoria University, Beyer professor of Zoology in Owens College, late fellow of St. John's College, Cambridge; new, revised, and cheaper edition of Finlayson's "Clinical Manual;" new edition of Farquharson's "Guide to Therapeutics;" new edition of Part I. of MacCormac's "Surgical Operations."

— This year's volume of the Annual of the Office of Naval Intelligence, just issued from the government printing office at Washington, is the tenth in the series of general information from abroad, and retains the title of last year's number, "The Year's Naval Progress." It has a chapter on ships and torpedo-boats, one on machinery, and one each on ordnance, electricity on shipboard, and the naval manœuvres of 1890. Chapter VI. treats of the armor question in its present aspect, as viewed in the light of recent practical tests; and Chapter VII. presents a view of the different systems of coast defence of the various European States. Other chapters are devoted to high explosives, torpedo vessels, and promotion in European navies; and the final chapter gives a list of books on professional subjects.

— Messrs. Sampson Low, Marston, & Co announce: "Theory and Analysis of Ornament," applied to the work of elementary and technical schools, by Francois Louis Schauermann, for eight years head master of the wood and carving department, Royal Polytechnic, Regent Street, with 263 illustrations; "Answers to the Questions on Elementary Chemistry," theoretical and practical (ordinary course), set at the examinations of the science and art department, South Kensington, 1887–91, by John Mills, formerly of the Royal College of Science, London, author of "Alternative Elementary Chemistry," fully illustrated; "Chemistry for Students," consisting of a series of lessons based on the syllabus of the science and art department, and especially designed to facilitate the experimental teaching of elementary chemistry in schools and evening classes, by John Mills, author of "Alternative Elementary

Chemistry," etc., numerous illustrations; "A Complete Treatise on the Electro-Deposition of Metals," comprising electro-plating and galvanoplastic operations, the deposition of metals by the contact and immersion processes, the coloring of metals, the methods of grinding and polishing, etc., translated from the German of Dr. George Langbein, with additions by William T. Brannt, editor of "The Techno-Chemical Receipt Book," etc., illustrated by 125 engravings; "Handwriting in Relation to Hygiene," being a paper read at the Seventh International Congress of Hygiene and Demography, London, 1891, by John Jackson, and the report of the commission of specialists appointed by the Imperial and Royal Supreme Council of Health, Vienna, 1891.

— Messrs. Blackie and Son have in the press a "Text-book of Agriculture," under the editorship of Professor R. P. Wright of the Glasgow and West of Scotland Technical College. They have also in preparation a series of "Guides to the Science Examinations" (the first number, which is nearly ready, is by Mr. Jerome Harrison of Birmingham, and deals with the examinations in physiography). Pinkerton's "Mechanics," in their series of science text-books, is about to enter a second edition, and the opportunity is being taken to adapt it to the revised requirements of the 1891 syllabus of the science and art department.

— During the coming winter Mr. Edward Arnold proposes to issue a series of popular papers on animals, by Professor C. Lloyd Morgan, the well-known author of "Animal Life and Intelligence;" "A Treatise on the Standard Course of Elementary Chemistry," by E. J. Cox, head master of the Technical School, Birmingham; and a series of scientific works by Doctor Wormell (the series will embrace text-books of mechanics, sound, light, heat, magnetism, and electricity).

— The following announcements are made by Messrs. Macmillan & Co.: "Essays on some Controverted Questions," by T. H. Huxley, F.R.S.; "Dr. Schliemann's Excavations at Troy, Tiryns, Mycenæ, Orchomenos, Ithaca, Presented in the Light of Recent Knowledge," by Dr. Carl Shuchhardt, authorized translation by Miss Eugenie Sellers, with appendix on latest researches by Drs. Schliemann and Dörpfeld, and introduction by Walter Leaf, illustrated with two portraits, maps, plans, and 290 woodcuts; "Beast and Man in India," by J. L. Kipling, with numerous illustrations by the author; "An Introduction to the Theory of Value," by William Smart; "Public Finance," by C. F. Bastable, professor of political economy, Trinity College, Dublin; "The Pioneers of Science," by Professor Oliver Lodge, with portraits and other illustrations; "Electricity and Magnetism: a Popular Treatise," by Amédée Guillemin, translated and edited, with additions and notes, by Professor Silvanus P. Thompson, with numerous illustrations, uniform with the English editions of M. Guillemin's "The Forces of Nature" and "The Application of Physical Forces;" "Island Life; or, The Phenomena and Causes of Insular Faunas and Floras," including a revision and attempted solution of the problem of geological climates, by Dr. A. R. Wallace, with illustrations and maps, new and cheaper edition; "A Complete Treatise on Inorganic and Organic Chemistry," by Sir Henry E. Roscoe, F.R.S., and Professor C. Schorlemmer, F.R.S., Vol. III. "Organic Chemistry; the Chemistry of the Hydrocarbons and their Derivatives, or Organic Chemistry," six parts, Part VI.; "A Text book of Physiology," illustrated, fifth edition, revised, Part IV. comprising the remainder of Book III. "The Senses and Some Special Muscular Mechanisms," and Book IV. "The Tissues and Mechanisms of Reproduction," by Michael Foster, F.R.S., professor of physiology in the University of Cambridge; "Text-book of Comparative Anatomy," by Dr. Arnold Lang, professor of zoology in the University of Zurich, formerly Ritter professor of phylogeny in the University of Jena, issued as the ninth edition of Edward Oscar Schmidt's "Hand-book of Comparative Anatomy," translated into English by Henry M. Bernard and Matilda Bernard, with preface by Professor Ernst Haeckel, 2 vols., illustrated (Vol. I. in October); "Materials for the Study of Variation in Animals" (Part I. Discontinuous Variation), by William Bateson, Balfour student and fellow of St. John's College, Cambridge, illustrated; "The Diseases of Modern Life," by Dr. B. W. Richardson, new and cheaper edition; "Ligation in Continuity," by Drs. C. A. Ballance and Walter Edmunds, with illustrations and plates; "The Dietetic Value of Bread," by John Goodfellow; "On Colour Blindness," by Thomas H. Bickerton, illustrated (Nature Series); "The Geography of the British Colonies" — "Canada," by George M. Dawson, "Australia and New Zealand," by Alexander Sutherland; "The Algebra of Co-Planar Vectors and Trigonometry," by R. B. Hayward, F.R.S., assistant master at Harrow; "The Elements of Trigonometry," by Rawdon Levett and A. F. Davison, masters in King Edward's school, Birmingham; "Progressive Mathematical Exercises for Home Work" (in two parts), by A. T. Richardson, senior mathematical master at the Isle of Wight College, formerly scholar of Hertford College, Oxford; "The Geometry of the Circle," by W. J. McClelland, Trinity College, Dublin, head master of Santry school, illustrated; "Mechanics for Beginners," by the Rev. J. B. Lock, author of "Arithmetic for Schools," etc., Part I. Mechanics of Solids, Part II. Mechanics of Fluids; "A Graduated Course of Natural Science for Elementary and Technical Schools and Colleges," by B. Loewy, examiner in experimental physics to the College of Preceptors, Part II. Second Year's Course; "Methods of Gas Analysis," by Walter Hempel, Ph.D., translated by Dr. L. M. Dennis; "Nature's Story Books," I. "Sunshine," by Amy Johnson, illustrated.

— The Clarendon Press promises "Geography of Africa South of the Zambesi," by W. Parr Greswell; "Mathematical Papers of the late Henry J. S. Smith, Savilian Professor of Geometry in the University of Oxford," with portrait and memoir, 2 vols.; "Plane Trigonometry, without Imaginaries," by R. C. J. Nixon; "A Treatise on Electricity and Magnetism," by J. Clerk Maxwell, new edition; "A Manual of Crystallography," by M. H. N. Story-Maskelyne; "Elementary Mechanics," by A. L. Selby; "Weismann's Lectures on Heredity,' Vol. II., edited by E. B. Poulton, F.R.S.

— In the October *Educational Review* Professor James H. Blodgett, special agent of the census for statistics of education, begins the interpretation of the educational statistics of the Eleventh Census; President Francis A. Walker argues for the higher appreciation of schools of technology; Professor Herbert B. Adams traces the beginnings of university entension in America; and John T. Prince of Massachusetts describes some of his recent experiences in the German schools. Other articles are by Professor Hanus of Harvard, Superintendent Aaron Gove of Denver, Dr. Larkin Dunton of Boston, Professor Hammer of Munich, and the editors. Book reviews are by Sir William Dawson of McGill College, Montreal, Professor B. I. Wheeler of Cornell, Professor Garnett of the University of Virginia, Professors Hyslop and Jackson of Columbia, Professor Sanford of Stanford University, Superintendent Calkins of New York, and the editors. This issue also contains the full text of the English act known as the "Elementary Education Act, 1891," which introduces free education on a large scale.

— The Cambridge University Press announces: "Catalogue of Scientific Papers Compiled by the Royal Society of London," new series for the years 1874–1883; "The Collected Mathematical Papers of Arthur Cayley, Sc.D., F.R.S., Sadlerian professor of pure mathematics in the University of Cambridge," Vol. IV. (to be completed in ten volumes); "A History of the Theory of Elasticity and of the Strength of Materials," by the late I. Todhunter, F.R.S., edited and completed by Karl Pearson, professor of applied mathematics, University College, London — Vol. II. Saint Venant to Sir William Thomson;" "A Treatise on Elementary Dynamics," new and enlarged edition, by S. L. Loney, fellow of Sidney Sussex College; "Solutions of the Examples in a Treatise on Elementary Dynamics," by the same author; "A Treatise on Thermo-dynamics," by J. Parker, fellow of St. John's College, Cambridge; "A History of Epidemics in Britain," Vol. I., from A.D. 664 to the extinction of plague in 1666, by Charles Creighton, M.D., formerly demonstrator of anatomy in the University of Cambridge; "Catalogue of Type Fossils in the Woodwardian Museum, Cambridge," by H. Woods, of St. John's College, with preface by Professor T. McKenny Hughes; "Examination Papers for Entrance and Minor Scholarships and Exhibitions in the Colleges of the University of Cambridge" — Part I. Mathematics and

Science, Part II. Classics, Mediæval and Modern Languages, and History (Michaelmas Term, 1890), Part III. Mathematics and Science, Part IV. Classics, Law, and History (Lent Term, 1891); and three volumes in the Pitt Press Mathematical Series — "An Elementary Treatise on Plane Trigonometry for the Use of Schools," by E. W. Hobson, fellow of Christ's College, Cambridge, and university lecturer in mathematics, and C. M. Jessop, fellow of Clare College; "Arithmetic for Schools," by C. Smith, master of Sidney Sussex College, Cambridge; "Solutions to the Exercises in Euclid, Books I.–IV.," by W. W. Taylor.

— A portrait of James Russell Lowell, made from a recent photograph, forms the frontispiece of the September *Writer*, which is a Lowell memorial number. The magazine opens with an article on "Lowell in Private Life," by John H. Holmes of Cambridge, brother of Oliver Wendell Holmes, and for years an intimate social companion of Mr. Lowell. Following this are personal tributes to Mr. Lowell, written at the request of the editor of the *Writer*, by Francis Ellingwood Abbott, C. A. Bartol, James Parton, Laurence Hutton, George Makepeace Towle, Thomas Nelson Page, Frank R. Stockton, Edward Everett Hale, N. P. Gilman, Edward Eggleston, Lucretia P. Hale, Edwin Lassetter Bynner, Margaret J. Preston, Agnes Repplier, Ernest Ingersoll, Arthur Gilman, George Parsons Lathrop, Oscar Fay Adams, James Jeffrey Roche, W. H. Furness, Louise Imogen Guiney, Joel Benton, Thomas S. Collier, Danske Dandridge, Lucy Larcom, Arlo Bates, Sylvester Baxter, Noah Brooks, Kate Field. An interesting comparison between Lowell and Matthew Arnold is made by Edward T. McLaughlin, assistant professor of English at Yale College. The *Writer* is working, in the interest of writers, for a reduction of postage rates on manuscripts, which now go at letter rates.

— J. B. Lippincott Company have published "The Natural History of Man," by Alexander Kinmont, being a series of lectures originally delivered and published some fifty years ago. The author was a Scotchman by birth and education, but settled in the United States when a young man, and labored here as clergyman and teacher. The subjects of the lectures are certain phases of human nature and human history, such as the races of mankind, the origin and uses of language, the predominance of the religious sentiment in early ages, the elements of American civilization, etc., all of which are treated from a religious point of view. There is no unity of plan in the book, so far as we can discover; but many of the topics are well handled, though without any striking originality. The distinguishing characteristic of the book is a simple and unaffected piety, which in these days of skepticism and half-hearted belief is refreshing. The moral tone of the lectures is also excellent, and the style is easy and flowing, though somewhat diffuse. The author's science and history are sometimes at fault, and there are passages in the book which could not have been written at the present day; yet to persons of a religious temper these lectures will be a source of interest and profit.

— Messrs. Longmans, Green, & Co. announce a new volume of "Fragments of Science: being Detached Essays, Addresses, and Reviews," by John Tyndall, F.R.S.; "About Ceylon and Borneo: being an Account of Two Visits to Ceylon, One Visit to Borneo, and how I Came Home and was Rocked to Sleep on the Bosom of — well, 'The Suez Canal,'" by Walter J. Clutterbuck, author of "The Skipper in the Arctic Seas," and joint author of "Three in Norway," and "B.C. 1887," with illustrations; "Anthropological Religion," the Gifford lectures delivered before the University of Glasgow in 1891, by F. Max Müller; "An Introduction to Human Physiology," being the substance of lectures delivered at the St. Mary's Hospital medical school from 1885 to 1890, by Augustus D. Waller; "Elements of Materia Medica and Therapeutics," with numerous illustrations, by C. E. Armand Semple, M.R.C.P. Lond., member of the Court of Examiners, and late senior examiner in arts at Apothecaries' Hall, etc.; "Outlines of Theoretical Chemistry," by Lothar Meyer, professor of Chemistry in the University of Tübingen, translated by Professors P. Phillips Bedson and W. Carleton Williams (this book, of about 200 pages, gives a concise account of the theories of modern chemistry, which, it is expected, will not only be of use to advanced students, but will also enable those who take a general interest in science, but are unfamiliar with the details of chemical investigation, to gain a general idea of the development of theoretical chemistry); "The Dynamics of Rotation," by A. M. Worthington, professor of physics, and head master of the Dockyard School, Portsmouth; "The Principles of Chemistry," by D. Mendeléef, professor of chemistry in the University of St. Petersburg, translated by George Kamensky, A.R.S.M. of the Imperial Mint, St. Petersburg, and edited by A. J. Greenaway, sub-editor of the Journal of the Chemical Society, 2 vols.; "A Manual of the Science of Religion," by Professor Chantepie de la Saussaye, translated by Mrs. Colyer Fergusson (*née* Max Müller), revised by the author; "Solutions: being an English translation (by M. M. Pattison Muir) of Book IV. Vol. I. of the second edition of Ostwald's 'Lehrbuch der allgemeinen Chemie.'"

— Messrs. A. and C. Black have in preparation: "Manual of Chemistry," by Dr. Alexander Scott, Durham; "Manual of Botany," by Dr. Scott, Bickley; "Dictionary of Birds," by Professor Alfred Newton and Dr. Gadow.

— Among the contents of the current number of the "Proceedings of the United States Naval Institute" are "Explosives and Ordnance Material," by S. H. Emmens; "The Effect of Waterline Damage on the Stability of Unarmored War-ships," by Charles Hemje; "Naval Reserve and Naval Militia," by Lieut. J. C. Soley, U.S.N.; "The Final Improvement of the Steam-Engine," by Dr. R H. Thurston; and the usual amount of professional and bibliographical notes.

— Among the most notable of standard and miscellaneous works announced by D. Appleton & Co. for publication will be Père Didon's "Life of Christ," in two volumes, with maps and forty-eight full-page illustrations; the third volume of Professor J. B. McMaster's "History of the People of the United States;" a new edition of Herbert Spencer's "Essays," with additions, in three volumes; "The Life of James Boswell" (two volumes), by Percy Fitzgerald, with four portraits; "Lady Dufferin's Journal of her Life in Canada," illustrated; "The Cause of the Ice Age," by Sir Henry Ball; "Man and the Glacial Period," by Professor G. Frederick Wright; "The Farmer's Side," by Hon. W. A. Peffer, United States Senator from Kansas; "Herbart's Psychology," translated by Margaret K. Smith; "The Courses of Study for Schools and Colleges," by W. T. Harris, United States commissioner of education; "Applied Psychology and Art of Teaching," by J. Baldwin; "Laboratory Practice," by Professor J. P. Cooke; and "The Dog in Health and Disease," by Wesley Mills, M.D.

— Amid all the wild speculation that is floating about just now respecting the overflow of the Colorado River into the desert, it is instructive to read such an article as the one in the October *Scribner* on "The New Lake in the Desert," by Major J. W. Powell, Director of the United States Geological Survey, who brings to the subject a thorough knowledge of natural conditions, and overthrows many extravagant theories both as to the past and future of the phenomenon. J. N. Hall, M.D., a hunter of experience, has an article in the same number of unique interest and of practical value to all sportsmen, on "The Actions of Wounded Animals;" and in an interesting article on "The Biography of the Oyster," whose life history we have hardly before properly appreciated, Mr. Edward L. Wilson, the well-known traveller and photographer, gives the following figures as representing the work of but one of the important centres of the oyster industry, "The Delaware Bay and Maurice River Cove Oyster Association" of New Jersey. In the fall of the year, when the business is at its height, from thirty to forty car-loads leave there daily, each one carrying away 100 sacks or barrels of oysters averaging 1,000 oysters. Thus from 3,000,000 to 4,000,000 are shipped daily.

— According to Bulletin No. 14 of the Iowa Agricultural Experiment Station, the clover seed caterpillar (*Grapholitha interstinctana*), which is described and figured in different stages, has been abundant and detructive, and the conclusion is reached that cutting the clover and storing it while the caterpillars are still in the clover heads results in the entire destruction of the insect. The same bulletin states that experiments with hopper dozers for grass-leaf hoppers show that this method can be used very successfully in capturing the insects; that the simplest form, a flat piece of sheet-iron, was most satisfactory; that one application resulted in adding thirty-four per cent to the crop of hay on a plat experimented on, and at one experiment leaf-hoppers were captured at the rate of 376,000 per acre. Kerosene emulsion for plant lice was used once with poor success, but later an application of a good emulsion by thorough methods resulted in complete success. Grasshoppers are mentioned as troublesome this season, and reports of Rocky Mountain grasshoppers are referred to. No present damage to Iowa is apprehended from this latter species, and methods of controlling the common native species, when numerous, are discussed. The flavescent clover-weevil is found abundant at Ames. Its distribution is referred to and its method of work described. Information regarding its occurrence in other parts of the State is requested. The wheat-bulb worm has occurred in moderate numbers, but abundant parasites have been found to attack it at Ames, and its serious multiplication is not considered probable.

— M. E. Heckel of Marseilles has recently described an interesting case of mimicry which may be frequently seen in the south of France. The mimic, *Nature* states, is a spider, *Thomisus onustus*, which is often found in the flowers of *Convolvulus arvensis*, where it hides itself for the purpose of snaring two Diptera, *Nomioides minutissimus* and *Melithreptus origani*, on which it feeds. Convolvulus is abundant, and three principal color variations are met with: there is a white form, a pink one with deep pink spots, and a light pink form with a slight greenishness on the external wall of the corolla. Each of these forms is particularly visited by one of three varieties of *Thomisus*. The variety which visits the greenish form has a green hue, and keeps on the greener part of the corolla; that which lives in the white form is white, with a faint blue cross on the abdomen, and some blue at the end of the legs; the variety which lives in the pink form is pink itself on the prominent parts of the abdomen and legs. If the animal happens to live on *Dahlia versicolor* the pink turns to red, and if it lives in a yellow flower — *Antirrhinum majus*, for instance — it becomes yellow. At first Professor Heckel supposed the three varieties of *Thomisus* to be permanent, but he discovered accidentally that any one of these peculiarly colored spiders, when transferred to a differently colored flower, assumes the hue of the latter in the course of a few days; and when the pink, white, green, and yellow varieties are confined together in a box, they all become nearly white.

— During the nesting season the male ostrich seems to be anything but an agreeable creature. In a paper lately read before the Royal Society of Tasmania (*Nature*, Sept. 10), Mr. James Andrew says that at that period the bird is most pugnacious, and may only be approached in safety with great precaution. He resents the intrusion of any visitors on his domain, and proves a most formidable opponent. His mode of attack is by a series of kicks. The leg is thrown forwards and outwards, until the foot, armed with a most formidable nail, is high in the air; it is then brought

Publications received at Editor's Office, Sept. 16–22.

BAILEY, L. H. Annals of Horticulture in North America for the Year 1890. New York, Rural Publ. Co. 312 p. 8°. $1.
DAVIS, G. G. Anales de la Oficina Meteorologica Argentina. Tomo VIII. Climas de Chacra de Matanzas, Corrientes, Catamarca, Mailin, y Cochinoca. Buenos Ayres, Coni 6 Hijos. 569 p. f°.
DAVIS, J. Woodbridge. Theoretical Astronomy: Dynamics of the Sun. (Woodbridge School Essays, No. 1.) New York, Woodbridge School. 97 p. 4°.
EMTAGE, W. T. A. An Introduction to the Mathematical Theory of Electricity and Magnetism. (Clarendon Press Series.) New York, Macmillan. 228 p. 12°. $1.90.
OCCULTISM, the Key of Nature. Vol. I. No. 1. Boston. 16 p. 4°.
RICHTER, V. von. Chemistry of the Carbon Compounds; or, Organic Chemistry. 2d ed. Philadelphia, Blakiston. 1040 p. 8°. $3.50.
WEISMANN, A. Essays upon Heredity and Kindred Problems. Vol. I. 2d ed. New York, Macmillan. 471 p. 8°. $2.

down with terrific force, serious enough to the unhappy human being or animal struck with the flat of the foot, but much worse if the victim be caught and ripped by the toe. Instances are known of men being killed outright by a single kick, and Mr. Andrew remembers, whilst on a visit in the neighborhood, that on a farm near Graaff Reinet a horse's back was broken by one such blow aimed at its rider. If attacked, a man should never seek safety in flight; a few yards and the bird is within striking distance, and the worst consequences may result. The alternative is to lie flat on the ground, and submit with as much resignation as possible to the inevitable and severe pummelling which it may be expected will be repeated at intervals until a means of escape presents itself, or the bird affords an opportunity of being caught by the neck, which, if tightly held and kept down, prevents much further mischief. Under such circumstances, however, Mr. Andrew has known a bird, with a badly-calculated kick, strike the back of its own head, scattering the brains — "a serious loss of valuable property to the farmer."

— Messrs. Tiffany & Co. have on exhibition a gold medal, weighing 4,296 grains, that was struck by order of the Prussian government as a recognition of the services rendered to science by Alexander von Humboldt. The medal is two and a half inches in diameter. On one side is the head of Alexander von Humboldt, with the name above, and the date, 1847, below, in Latin letters. This is interesting because the die has been so given the appearance of undercutting that the reverse of the head can be seen on the polished surface of the medal. On the reverse side are the signs of the Zodiac arranged around the edge, and in the centre is a figure of Science, with the right hand unveiling a Goddess of Plenty. From the other hand is a line and plummet, sounding the depths of the sea, in which are dolphins and other forms of marine life. On the border, in minute letters, are the names of the designer, the renowned fresco painter, P. von Cornelius, and the artist who cut the die, K. Fischer. This is the original medal given to Humboldt. The only duplicate was given to the king at the time it was made.

SCIENCE

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SCIENCE

NEW YORK, OCTOBER 2, 1891.

THE EVOLUTION OF ALGEBRA.[1]

In considering the possible subjects for an address on this occasion, it has seemed to me that a half-hour might be agreeably spent in a brief survey of the progress, or evolution, of algebra from its earliest known beginnings to the present time.

The realm of mathematics may be classified, in a general way, into (1) Arithmetic, or the theory of numbers, (2) Algebra, (3) Geometry, though sharp dividing lines cannot always be drawn between these departments: the last two, for instance, mutually interacting, geometry illustrating algebra, while algebra is the efficient servant of geometry, enabling it to conquer territory which it could scarcely have entered upon unaided.

The history of the development of these different branches of mathematics shows considerable diversities among them. Thus geometry reached in a short time, among the ancient Greeks, a high stage of advancement, and then became practically stationary until quite recent times, while the progress of algebra has been more in the nature of a gradual and continuous evolution. Nesselmann has recognized three stages in this development, which he designates as the rhetorical, the syncopated, and the symbolical, to which I may perhaps venture to add the "multiple," in which a plurality of fundamental units is recognized and treated. We may regard the first three as somewhat analogous to the stone, bronze, and iron ages in human history, overlapping each other, as do these, at different times and places; while the last may be compared to that age of aluminum which is perhaps dawning upon the world.

Rhetorical algebra was a process for determining the unknown quantity in an equation by a course of logical reasoning expressed entirely in words, without the use of any symbols whatever, similar to our present mental arithmetic. In course of time abbreviations of those words which constantly recurred were introduced, by the use of which the statement of the reasoning could be much shortened, it being even possible with the notation of Diophantos to approximate to the conciseness of the modern, or symbolic, method. This, however, was not done by Diophantos himself, who used his abbreviations strictly as such, and reasoned out his results in words combined with these. This method is what is designated by Nesselmann as the syncopated, and forms evidently a stepping-stone toward the symbolic, in which perfectly arbitrary symbols are employed to represent the various quantities dealt with, and no words are written out except a conjunction now and then.

The earliest traces of algebraic knowledge which have been discovered are found in Egypt, that wonderful land whose records carry us back to such a remote antiquity. Ahmes, in a papyrus manuscript, dating from about 1400 B.C., deals with certain geometric and algebraic problems, and seems to have had as good a conception of the symbolism of algebra as his successors of a much later period. Thus he had signs for $+$, $-$, and $=$, and used the character representing a heap for the unknown quantity. He seems, therefore, to have long anticipated Diophantos in the use of syncopated notation. Our knowledge of Egyptian mathematics subsequent to this time is very slight, and is gleaned from the statements of various Greek and Latin authors.

We will pass, then, at once to the Greek contributions to the development of our subject. So far as can now be ascertained, probably but little strictly algebraic work was done before the third or fourth century of our era, though opinions differ on this point. The wonderful accomplishments of Archimedes were mainly geometrical and mechanical, though he makes one remark which is equivalent to a statement regarding the roots of an equation of the third degree, which is remarkable as being, with one exception, the only known case of any consideration of such an equation until after the lapse of more than a thousand years from his time.

Thymaridas in the second century of our era is the earliest mathematician known to have enunciated an algebraic theorem. This was, however, done entirely in words, no symbol for any quantity or operation being used.

Practically the foundation of algebra was laid by Diophantos of Alexandria. But little is known of this remarkable man. Though we have his writings in Greek, he was probably not himself a Greek. The period at which he lived is in dispute, though probabilities favor the fourth century of our era. Even the spelling of his name is uncertain, there being a question as to whether the last syllable should be *os* or *es*. But whatever may be known or unknown about the man himself, his writings show a very wonderful power of analytic reasoning, especially when we consider the awkwardness of the tools with which he was obliged to work.

What strikes us at once, from our present point of view, as most hampering is the fact that he had only one symbol for the unknown, so that, in dealing with a problem which would now be solved by the aid of several such symbols, as x, y, z, etc., he was obliged to adopt some expedient, such as to make mentally such combinations and arrangements as to get along with only one. It is easy to see how much ingenuity must often have been required to accomplish this. It is a curious and surprising fact that algebraic analysis was subjected to this same limitation down to a comparatively recent period. In place of the exponents at present used to indicate the powers to which quantities are raised, Diophantos designated the square and cube of the unknown by the initial letters of the corresponding words in Greek. Thus the unknown is represented by the character ς, standing for the word ἀριθμός (i.e., number), which is also frequently written out in full; the square of the same by δ^{υ}, a contraction for δύναμις (power); and the cube by κ^{υ}, a contraction for κύβος (cube). Higher powers up to the sixth were indicated by combination or repetition of these symbols. The origin of the character for *arithmos* is uncertain; it may be the final sigma of this word, or it may be a contraction of αρ, the first two letters of the same, or it may be derived from an old Egyptian symbol for the unknown. When oblique cases of these quantities are required, the words for square and cube are written out in full, while the practice varies with regard to *arithmos*, the word being sometimes

[1] Address before the Section of Mathematics and Astronomy of the American Association for the Advancement of Science, at Washington, D.C., Aug. 19–25, 1891, by E. W. Hyde, vice-president of the section.

written out, while at other times the case-termination is written above to the right, thus $\varsigma^{o\upsilon}$, the symbol being also generally doubled when the signification is plural.

Diophantos indicated addition merely by juxtaposition, having no sign for plus; for minus, however, he used the sign ⋔. As a consequence, in order to avoid confusion, he was obliged to do two things; first, to designate the absolute term as so many μονάδες, or units, abbreviated into μ^{o}, and second, to write all the negative terms together after the positive. Thus the quantity $x^3 - 5x^2 + 8x - 1$ would be written in Diophantos's notation.

$$\kappa^{\upsilon}\ \tilde{\alpha}\ \varsigma\varsigma^{o\iota}\ \tilde{\eta}\ ⋔\ \delta^{\upsilon}\ \tilde{\varepsilon}\ \mu^{o}\ \tilde{\alpha}.$$

This may be rendered more expressive if we change it by substituting Arabic numerals, and putting U for units, N for number or unknown, S for square, and C for cube: thus it becomes $C\,1\,N\,8 - S\,5\,U\,1$.

It is to be noted that Diophantos and his successors up to comparatively recent times had no conception whatever of an intrinsically negative quantity as possible. Whatever sign may have been used for minus was considered as simply indicating that one number was to be subtracted from another, and if the subtrahend were larger than the minuend no meaning was attached to the expression.

It is possible that Diophantos might have been able to escape from the limitations of his system if the letters of the Greek alphabet had not been already appropriated for the representation of particular numbers, thus precluding their use as symbols of quantity in general.

It may be of interest to give at this point specimens of the purely rhetorical and of the syncopated methods of solution. They are given by Nesselmann, and are verbatim translations from the original tongues. The first is a solution of a quadratic equation by Mohammed ibn Musa, and the second the solution of a problem by Diophantos.

A square and ten of its roots are equal to nine-and-thirty units, that is, if you add ten roots to one square, the sum is equal to nine-and-thirty. The solution is as follows: halve the number of roots, that is, in this case, five; then multiply this by itself, and the result is five-and-twenty. Add this to the nine-and-thirty, which gives four-and-sixty; take the square root, or eight, and subtract from it half the number of roots, namely, five, and there remains three: this is the root of the square which was required and the square itself is nine.

(S = square, N = number, U = unit, as above.)

To divide the proposed square into two squares: Let it be proposed, then, to divide 16 into two squares; and let the first be supposed to be one square. Thus 16 minus one square must be equal to a square. I form the square from any number of N's minus as many U's as there are in the side of 16 U's. Suppose this to be 2 N's minus 4 U's. Thus the square itself will be 4 squares 16 U's minus 16 N's. These are equal to 16 units minus 1 square. Add to each the negative term, and take equals from equals. Thus 5 squares are equal to 16 numbers. One (square) will be 256 twenty-fifths, and the other 144 twenty-fifths, and the sum of the two makes up 400 twenty-fifths, or 16 units, and each is a square.

Compare these long-drawn-out statements with their equivalents in modern notation:

First.	Second.
$x^2 + 10x = 39$	$16 - x^2 = \square = (2x - 4)^2$
$x^2 + 10x + 25 = 64$	$= 4x^2 + 16 - 16x$
$\therefore\ x + 5 = 8$	$\therefore\ 16x = 5x^2$
$\therefore\ x = 3$	$\therefore\ x = \frac{16}{5}$

The example from Diophantos evidently does not take full advantage of his notation, for the symbol for minus is not used, and in several cases the words are written out in full where abbreviations might have been employed. Further, no use is made of the symbol for equality, viz., ἰ, an abbreviation for ἴσοι, which is elsewhere used by the author. If the fullest use of the syncopated notation had been made, the solution would have been somewhat comparable for conciseness and brevity with the modern method, only about twice as many characters and marks being required. Solutions in this abbreviated form appear on the margins of Diophantos's manuscripts, but they are believed to have been added by some one else, and not to be due to the author himself.

The works of Diophantos, called by him "Arithmetics," deal largely with indeterminate equations and the theory of numbers. Quadratic equations are constantly solved, but only real positive results are recognized or considered; and even when there are two positive roots, only one is taken account of. One very simple case of an equation of the third degree is found.

We will turn next to the consideration of the ancient algebra of India. There lived at Patna, in India, some time in the sixth century of our era, a mathematician named Arya-Bhatta, who wrote a work treating of arithmetic, algebra, geometry, trigonometry, and astronomy. It consists in the enunciation of rules and propositions in verse. The author gives, of course in a purely rhetorical manner, the sums of the first, second, and third powers of the first n natural numbers, the general solution of a quadratic equation, and the solution in integers of some indeterminate equations of the first degree.

The only other ancient Indian mathematician of prominence is Brahmagupta, who lived in the seventh century of our era. His work is also written in verse, and is called "Brahma-Sphuta-Siddhauta," or the "System of Brahma in Astronomy." Two chapters of this work deal with arithmetic, algebra, and geometry. The treatment of algebra is purely rhetorical, and includes a discussion of arithmetical progressions, quadratic equations (only the positive roots being considered), and indeterminate equations of the first degree, together with one of the second degree.

These Indian writings are of special interest as being the sources from which the Arabs derived their first knowledge of algebra. They obtained from the Greeks before A.D. 900, thorough translations of Euclid, Apollonius, Archimedes, and others, a knowledge of geometry, mechanics, and astronomy, but had no translation of Diophantos till a hundred and fifty years later, when they had themselves already made considerable progress in algebraic analysis. From the Arabians in turn western Europe obtained, not only the decimal notation of arithmetic, but also its first knowledge of other branches of mathematics.

The first great mathematician among the Arabs is generally known by the name of Alkarismi, though this is an incorrect transliteration of only one of his names. From the title of his work, "Al-gebr we'l Mukabala," we have the name of that branch of mathematics under consideration, al-gebr signifying that the same quantity may be added to or subtracted from both sides of an equation.

Alkarismi treats the quadratic, giving geometric proofs of rules for the solution of different cases, and recognizing the existence of two roots, though he only considers such as are real and positive. He treats only numerical equations, and no distinction is made between arithmetic and algebra. This is true likewise of his Arabian successors, who, though they advanced so far as to obtain the general solution of a cubic equation, and to state such a proposition in integers of the equation $x^3 + y^3 = z^3$ is feasible, yet always adhered to the rhetorical method, and made scarcely any progress in general algebraic science. Indeed such progress was hardly possible until the introduction of symbolic methods.

The first decided steps in the direction of symbolism since the work of Diophantos were taken by a mathematician of India named Bhaskara in the twelfth century. He used abbreviations and initials to denote the unknown, a dot for minus, and juxtaposition to indicate addition. A product is denoted by the first syllable of the word for multiplication subjoined to the factors, division by the divisor being written beneath the dividend without a line between as our custom is now. The two sides of an equation are written one under the other, and explanatory records are introduced whenever it is necessary to prevent misunderstanding. Occasionally symbols are used for given as well as unknown quantities. Square, cube, and square root are denoted by the initial letters of the corresponding words. Using the Arabic, or decimal, notation, he has a character for zero, which enables him to write all his equations with all the powers of the unknown arranged in regular order on each side of the equation, certain of them being multiplied by the factor zero. This method of writing equations maintained itself till long afterwards. We have in this author a distinct advance over Diophantos and the Arabians in the introduction of various symbols for the unknown, so that several might be used in the same problem, as well as in the use of zero.

We have now to consider a new phase of algebraic progress arising from the introduction into western Europe of the works of the Arabian mathematicians. This took place through the Moors of Spain. The Greek and Arabic works were studied at the Moorish universities of Granada, Cordova, and Seville, but all knowledge of them was jealously kept from the outside world until the twelfth century, during which copies came into the possession of Christians. Up to this time Christian Europe had been almost a mathematical blank. The simple arithmetical operations they were able to perform were accomplished by the aid of the abacus, and they possessed some knowledge of astronomy and geometry, but made no progress until they were able to avail themselves of the previous labors of Greek, Hindu, and Arab, under the stimulus of which a career of advancement began which has continued to the present time. This career, however, did not begin immediately; it took several centuries to assimilate the material received from these sources, and thus to lay the foundations on which subsequent progress should rest.

During this period the rhetorical method was used in all algebraic processes, and it was not until the sixteenth century that syncopated methods were introduced, preparing the way for the symbolic methods that soon followed. Latin being the language in use, the word *res*, or *radix*, was employed for the unknown quantity, the square being called *census*, and the cube *cubus*. These words were at first written out in full and afterwards represented by R or Rj, Z or C, and C or K respectively.

The signs $+$ and $-$ are first found in a mercantile arithmetic by Johann Widmann, published in 1489, though they did not come into general use by mathematicians till a hundred years or more afterward. The most probable supposition as to their origin is that they were at first warehouse marks indicating an excess or deficiency in the contents of a package which was supposed to contain a certain definite amount. Widmann uses them purely as abbreviations, not as symbols of operation.

The first mathematical work ever printed was by Pacioli, upon arithmetic, algebra, and geometry, and marks the beginning of the syncopated stage of development in western Europe. This book appeared in 1494, just before the beginning of the sixteenth century, during which this method was in vogue. Pacioli uses initials as abbreviations for the unknown, its square and cube, and for the words "plus" and "equal," also occasionally *de* for *demptus*, instead of minus.

The sign now used for equality was introduced by Recorde in an arithmetic published in 1540. He uses also the present signs $+$ and $-$. At about the same time our present symbol for square root was introduced by Stifel, and Nicholas Tartaglia discovered the solution of the cubic equation $x^3 + px = q$, which is generally attributed to Cardan, and goes by his name. Cardan obtained the solution from Tartaglia under promise of strict secrecy, and then published it in his work "Ars Magna." Considerable advance is made in this work over anything done by his predecessors. Negative and even imaginary roots of equations are discussed, and the latter are shown to always occur in pairs, though no interpretation of them is attempted. Cardan shows that when the roots of the cubic are all real, Tartaglia's solution appears in an imaginary form. This is the first notice we find of imaginaries, and, with the exception of a similar treatment by Bombelli a few years later, and a suggestion as to their interpretation by Wallis in 1685, they were discussed by no subsequent mathematician until Euler investigated them nearly two hundred years afterward. Cardan also discovered the relations between the roots and coefficients of an algebraic equation, and the underlying principle of Descartes' rule of signs. It is to be noted that his solutions both of quadratics and cubics are geometrical.

In 1572 Bombelli published an algebra in which the same subjects discussed by Cardan are treated in about the same way, but in which a marked advance is made in notation, viz., the employment for the unknown of the symbol $\underset{\smile}{1}$, while its powers are denoted by $\underset{\smile}{2}$, $\underset{\smile}{3}$, etc. Thus he would write $x^2 + 5x - 4$ as $1\underset{\smile}{2}\,p.\ 5\,\underset{\smile}{1}m.\ 4$, $p.$ and $m.$ standing for plus and minus. Other writers of the same period would have written the expression thus,

$$1Z\,p.\ 5R\,m.\ 4, \text{ or } 1Q + 5N - 4.$$

Up to this time in the development of algebraic notation, whatever may have been the forms or symbols used, they were regarded simply as abbreviations for the words necessary to express the idea to be conveyed. But now the conception of pure symbolism begins to appear. Vieta, who lived in the last half of the sixteenth century, denoted known quantities by consonants and unknown by vowels, while powers were indicated by initials or abbreviations of the words *quadratus* and *cubus*. He was thus enabled to deal with several unknowns in the same problem, together with their powers. The following is a specimen of his notation. The equation $3BA^2 - DA + A^3 = Z$ he writes as

B 3 in A quad. — D plano in A + A cubo equatur Z solido.

(It may be noted that he makes his equations homogeneous, and lays stress on the desirability of so doing.) This and the other examples that have been given above illustrate the great variety of notations in use during this period, no conventional system having yet been adopted to be adhered to in the main by all mathematical writers. This is, of course, an inevitable accompaniment of the formative stage of any branch of science, when a few men are working here and there in comparative isolation. This variety continued to a considerable extent throughout the seventeenth century.

In this century we arrive at a new era in mathematical development. This was brought about by the application of algebra to geometry by Descartes in the early part, and the discovery of the differential calculus by Newton and Leibnitz independently in the latter part of the century. Algebra had been used in connection with geometry before Descartes, but to him was due the discovery of the fact, that, if the position of a point be given by co-ordinates, then any equation involving those co-ordinates will represent some locus all of whose properties are contained implicitly in the equation, and may be deduced therefrom by ordinary algebraic operations.

Descartes initiated the custom, which has become fixed, of using the first letters of the alphabet for known and the last for unknown quantities. He also appears to have been the first to perceive that one general proof is sufficient for any proposition algebraically treated, the different cases which might arise by different arrangements of the equations being covered by the possibility of any letter representing a negative as well as a positive quantity, i.e., he distinguished the intrinsic sign of a quantity or symbol. Hitherto it had been considered necessary to treat separately the forms of the quadratic $ax^2 + bx = c$, $ax^2 = bx + c$, etc., which was a natural result of the geometric method of arriving at the solution. Descartes also introduced our present notation for powers, taking his exponents, however, only as positive and integral.

Contemporaneously with Descartes, Cavalieri, in Italy, applied the so-called "method of indivisibles" to the computation of areas, volumes, etc., a process which gave way early in the eighteenth century to the integral calculus. At this time, also, the beginnings of the mathematical theory of probabilities were made by Pascal and Fermat in the solution of a certain problem which had been proposed.

A tremendous impulse was given to all branches of mathematics in the latter part of the seventeenth century by the genius of Newton. Besides his epoch-making discovery of the "theory of fluxions," or differential calculus, he contributed to algebraic science the idea of the general exponent or nth power (n being positive, negative, integral, or fractional), the binomial theorem, and a considerable part of the theory of equations.

To Leibnitz we owe the present notation of the differential calculus, the introduction of the terms "co-ordinates" and "axes of co-ordinates," and suggestions as to the use of indeterminate coefficients and determinants, which, though not developed by him, led, in the hands of others, to important results.

Jacob Bernoulli developed the fundamental principles of the calculus of probabilities, and made the first systematic attempts to construct an integral calculus. His brother John developed the exponential calculus, and treated trigonometry independently as a branch of analysis, it having been previously regarded as an adjunct of astronomy. The possibility of a calculus of operations was first recognized by Brook Taylor, after whom "Taylor's theorem" is named. De Moivre contributed to the discussion of imaginaries the important theorem which bears his name. In 1748 MacLaurin published an algebra which contained the results of some earlier papers published by him, among others one on the number of imaginary roots of an equation, and one on the determination of equal roots by means of the first derivative.

In the latter part of the eighteenth and beginning of the nineteenth centuries mathematical advancement was rapid under the powerful hands of Euler, Lagrange, Laplace, and Legendre. To these great men we owe the calculus of variations, the initial discussion of the calculus of imaginaries (which was afterwards systematized and developed by Gauss, Cauchy, and others), the treatment of determinants, contributions to the theory of equations, a large part of the integral calculus and differential equations, the development of the theory of probabilities, the treatment of elliptic functions, the method of least squares, and the specially algebraic treatment of the theory of numbers. In this list are included only those things which are of an algebraic nature.

We have now reached the beginning of our own century, in which the advance has been so rapid in all directions as to preclude more than a mere indication of some of the lines along which this has taken place, without any attempt at an enumeration of the illustrious names of those who have so magnificently carried forward the work.

The theory of equations has been perfected by the full use of the complex unit $a + bi$, forming thus, in the words of Cayley, a "universe complete in itself, such that, starting in it, we are never led out of it." We have, in fact, a double algebra as the instrument for the complete treatment of all higher analysis, except that in which one of higher multiplicity is used. The field of quantics has been brilliantly cultivated by Cayley, Sylvester, and others. The theory of matrices has been developed by Cayley, and it was shown by Professor J. Willard Gibbs, in his vice-presidential address before this section at the Buffalo meeting in 1886, that the simple and natural expression of this theory is in the language of multiple algebra. The φ of Hamilton is a matrix of the third order, and the Q of Grassmann a matrix of the nth order.

In the treatment of differential equations we have an algebra of operations, due primarily to George Boole, carried to a high degree of perfection, in which the symbol of differentiation is treated precisely as if it were a real quantity. In fact, we have come to regard scalar multiplication simply as a particular case in the calculus of operations which covers every possible case of the effect of one symbol upon another in producing some change in it. A further extension of this same idea we have in the algebra of logic, invented by the same author, and cultivated and extended by others since his time.

In conclusion, I propose to sketch briefly the development of the idea of a multiplicity of fundamental units, which is pervading more and more the mathematical thought of the day. This proceeded along two distinct lines, one arising from the interpretation of the imaginary, $\sqrt{-1}$, and the other entirely independent of this symbol or operation.

The first attempt to give a geometric meaning to the expression $a + bi$ appears to be due to Wallis in 1685, who proposed to construct the imaginary roots of a quadratic by going out of the line on which they would have been laid off if real. In 1804 the Abbé Buée devised the now accepted representation by laying off the terms containing i as a factor, at right angles to the others, and showed how to add and subtract such expressions as $a + bi$. At about the same time Argand published independently the same idea, and still further developed it. The concept of a directed quantity as represented by an algebraic symbol was thus necessarily arrived at. Gauss, Cauchy, and others have elaborated the complex unit more especially in the theory of numbers, while Euler, Peacock, De Morgan, and others have developed it more as a double algebra.

Up to this point i had been regarded as a scalar operator merely, and the corresponding geometry only plane, though attempts had been made without much success to extend the treatment into three-dimensional space. It remained for Hamilton to accomplish this by the simple device of making i a directed operator, or handle, perpendicular to the plane of rotation, which opened the way for any number of similar operators differing in direction, but, as to their other properties, simply square roots of minus one. In order to produce a convenient algebra on this basis, Hamilton was obliged to take the further step of giving to all vectors the properties of $\sqrt{-1}$, and thus the calculus of quaternions was produced, a non-commutative quadruple algebra. These ideas have been generalized still farther by Unverzagt in his "Theorie der goniometrischen und der longimetrischen Quaternionen." In this book the author first develops a trigonometry based on a general instead of a right-angled triangle, and then shows that the operator $j = (-1)^{\frac{\lambda}{\pi}}$ (in which λ is the fundamental angle, taking the place of $\frac{\pi}{2}$) takes in this trigonometry the place of i in De Moivre's theorem generalized. He then takes three units j_1, j_2, j_3, corresponding to Hamilton's i, j, k, and forms a generalized quaternion, based on some angle λ, which reduces to the ordinary system when $\lambda = \frac{\pi}{2}$. The case particularly discussed is that in which $\lambda = 0$.

The theory and laws of linear, associative algebras, which includes quaternions as a particular case, have been thoroughly treated by Peirce in his work bearing that title.

We turn now to the other line along which multiple algebras have been developed. In 1827 Möbius published his "Barycentrische Calcül," in which points are the ultimate units, to which any desired weights may be assigned. He gave the laws of combination of these units so far as addition and subtraction are concerned, but did not proceed to multiplication: in fact, he distinctly states that they can be multiplied only by numbers. He then proceeds to treat analytical geometry on this basis. His treatment of points, so far as it goes, is on the same plan afterwards independently developed by Grassmann.

In 1844, one year after Hamilton's first announcement of his discovery, Grassmann published his "Ausdehnungslehre," which contains a complete and logical exposition of his new algebra for any number of independent units, and hence, geometrically interpreted, for space of any dimensions. This book was so abstract and general in form, and so unlike the ordinary language of mathematics, that it attracted hardly any notice, and the author was obliged to recast and republish it in 1862. Grassman's algebra is non-linear, and only partially associative, so that it differs fundamentally from all those discussed by Peirce. The $\sqrt{-1}$ plays no part whatever in the theory, and Grassman's vector is a vector pure and simple, i.e., a quantity having direction and magnitude, and not, as in quaternions, a *versor*-vector, combining the properties of a vector and of the $\sqrt{-1}$. The fundamental notion of Grassmann's multiplication is extension or generation; the product $p_1 p_2$ is the line generated by a point moving straight from p_1 to p_2, etc.

In this great invention of Grassman we have a multiple algebra which is the natural language of geometry and mechanics, dealing in a manner astonishingly simple, concise, and expressive with these subjects, and certain, it appears to me, to gain constantly in the appreciation of mathematicians as it is more generally understood and used. The fact of its perfect adaptability to n-dimensional space is an additional argument in its favor for those who are interested in that line of investigation.

We have now traced the development of our subject from its elementary beginnings through a long period in which it was in the rhetorical stage, approaching at intervals here and there to the syncopated; then, on the revival of learning in Europe after the dark ages, we have seen its comparatively rapid progress through the syncopated stage to the purely symbolical, when it was at last in a shape suitable for the astonishing progress of the last two hundred years. Finally, in the present century, we have noted the appearance, as in the fulness of time, of multiple algebras from different and independent sources, whose realm is that of the future.

NOTES AND NEWS.

THE astronomers sent to the Sandwich Islands recently on the part of the International Geodetic Association of Europe and the United States Coast and Geodetic Survey, in order to make a more exhaustive study of the changes of latitude, have located their observatories at Waikiki, near Honolulu. It is proposed to observe during the year about sixty-five pairs of stars, chosen on account of their well-determined proper motions, and to make in all not far from twenty-five hundred observations of the latitude. The results, compared with those made simultaneously in Europe and America, will settle definitely the question whether there is a real motion of the pole. At the suggestion of the American representative, the force of gravity will be measured every night that latitude observations are made. This may throw light on one of the theories proposed to explain the changes of latitude, viz., that of large transfers of matter beneath the earth's surface. The new pendulums made at the Coast and Geodetic Survey Office in Washington, and which are similar to those taken to Alaska by Professor Mendenhall last spring, will be employed at Waikiki. They are of fine workmanship, and are capable of detecting changes that do not exceed one hundred-thousandth part of the quantity measured. Besides the observations at the regular station, a number of magnetic determinations will be made at other points in the Islands, — notably at Kealakeakua Bay, where Captain Cook observed the declination more than a hundred years ago, and at Lahaina, where De Freycinet had an observatory for pendulum and magnetic work in 1819. The re-occupation of these points will show the change of the needle during the past century, and will be of great value in determining the secular variation. It is intended also to seize the opportunity now presented to measure the force of gravity on the summit of Mauna Kea (14,000 feet elevation). Observations made at the top of Haleakala (10,000 feet) in 1887 showed conclusively that the mountain was solid. This fact received additional support from the zenith observations at the sea-level north and south of the mountain. The large deviation of the plumb line (29″) brought to light in that work has now been exceeded on Hawaii, where 1′ 26″ has been discovered at the south point of the island (Ka Lae). This fact, recently communicated by Surveyor-General Alexander, makes the question of the force of gravity at the summit of Mauna Kea one of double interest, and it is desirable, both from a geological and geodetic standpoint, that pendulum observations be made on top of one of the mountains. Doctor Marcuse, who is from the Royal Observatory at Berlin, observes for latitude on the part of the European association, and Mr. Preston, who made the observations at the summit of Haleakala four years ago, is from the United States Coast and Geodetic Survey, and makes gravity and magnetic determinations. He also, as the representative of the United States, observes for latitude in connection with Dr. Marcuse, in the international geodetic work. The observers had the good fortune to arrive at Honolulu on the day preceding the transit of Mercury (9th of May), and made successful observations of the phenomenon. The second contact was also observed by Mr. Lyons of the government survey. The two interior contacts were noted by local mean time (Waikiki 8″ east of Honolulu) as follows: —

	H.	M.	S.	H.	M.	S.
Mr. Lyons	1	26	32	—	—	—
Mr. Preston		26	53	6	10	50
Dr. Marcuse		27	3		11	22

The station was in latitude 21° 16′ 21″ north, and in longitude 157° 49′ 30″ west. The mean observed times of contact are in both cases about a minute less than the computed ones.

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THE EVOLUTION OF THE CEREBELLUM.

THE cerebellum has unquestionably given more trouble to anatomists than almost any other organ, and our present knowledge of its structure seems disproportionate to the labor expended. It is no discredit to the monumental works of Stilling, Meynert, Purkinje, Gerlach, and Kölliker to admit that scarcely a single tract connecting the cerebellum with other portions of the brain is traced with sufficient detail. Even the external configuration of the cerebellum in lower animals has many lessons for us which may be useful in the interpretation of the human organ.

The cerebellum is subject to a greater range of variation than any other organ of the brain. From being practically absent, as in amphibia, to preponderating over all other segments of the brain in some fishes, there is every gradation in development. It becomes obvious from a brief study of the relative development of the regions of the encephalon that the cerebellum does not vary in proportion to the intelligence; that, in other words, it cannot be employed as a criterion of the position of the animal in the scheme of classification as can the cerebrum. Although not available for taxonomic purposes, these variations are none the less interesting from the clew which they may afford to the functions and laws of development of this and associated organs.

In the March number of the *Journal of Comparative Neurology* the writer called attention to the architectural modifications of the cerebellum in reptiles, and the progressive evolution of the organ in the several groups, as well as the resemblance of this course of evolution to a peculiar and apparently undescribed law of development of the cerebellum in mammals.

The cerebellum is peculiarly mobile, considered architecturally, by reason of its mode of attachment to the axis of the brain. It is morphologically the roof of the fourth ventricle. Both before and behind it is connected with the doral surface of the brain-tube by a velum, or thinned lamina, devoid of nervous matter, and extensively folded and combined with vascular sinuses to form a nutritive organ, the plexus choroideus (metaplexus and mesaplexus). The velum posterior extends about the sides of the cerebellum also, so that rigidity is given to that organ only by the several fibre-bundles or peduncles of the cerebellum which connect it laterally with other regions. Thus, however large and heavy it may be, the cerebellum is supported solely by a lateral axis entering at the base. There is really nothing to prevent the most extensive rotations or foldings of the body in all directions except laterally.

The progressive development of this region is nowhere more conveniently illustrated than in the reptiles. Taking the transverse bar which constitutes the cerebellar rudiment in amphibians as a point of departure, we first encounter a leaf-like body with the ventricular half of the substance composed of granular material. The tracts are chiefly scattered in the dorsal white layer. In the serpents this flap is flexed so as to form a hood-like body. The flexture is due to the so-called pons-flexture of the whole medulla. The flexture is more pronounced in turtles, and results in a complete roof over the fourth ventricle, which may be considerably arched. It is obvious that there must be a limit to the development along this line. In higher reptiles, whose motions are more active and require more accurate co-ordination, the increase in size necessary to supply sufficient nervous matter renders necessary a complete eversion of the leaf like organ. In the lizards the lamina is folded forward in such a way as to make a double roof over the ventricle, bringing the granular layer, with its neuro-epithelium dorsad, in the superior layer, while it faces ventrad (toward the ventricle) in the ventral lamina. In the alligators the development is more extensive, and results in a horizontally placed hollow cone, with the apex directed caudad, and attached by the ventral portion of its base to the brain base. The outside of the cone is clothed with epithelium, while the inside is the morphologically ectal surface. Of course, in this description the thin velum which originally connected the edges of the leaf has been disregarded. This eversion of the cerebellum is of the highest importance in preparing us to understand the origin of the cellular elements in the human cerebrum. Before alluding to this subject we may pass in review a few illustrations of cerebellar architectonic from other classes of vertebrates.

In fishes the range of variation is remarkable, in so far that it may render the brains of closely allied genera very dissimilar in appearance. The characteristics of the fish cerebellum, which serves to distinctly separate it from all other classes of mammals, is the development of a second portion of the organ in front of the valve of Vieussens, which is the morphological anterior (cephalad) margin of the cerebellum in other cases. The relatively large amount of cerebellar substance required by active fishes, and the lack of definite walls to the ecephalic cavity, result in curious folds on a large scale and simple plan. The forward fold in front of the valve, which the writer has termed volvula, from its purse-like form, often completely fills the cavity of optic lobes, and in some cases (as the black-horse, *Cycleptus*), actually pries the two halves of the roof or tectum of that organ apart, and protrudes upon the dorsal surface with only the membranous velum tecti above it. The moon-eye, *Hyodon*, is the most reptilian of the osseous fishes so far examined, and in this case the cerebellum proper is a simple sac extending caudad: there is no external evidence of a volvula or of lateral lobes or "bursa." Sections show, nevertheless, that there is a small volvula which lies, as in *Lepidosteus*, in the posterior part of the optic ventricle.

One curious result of the development of a volvula is the peculiar course by which the fourth cranial nerve reaches its centre. Entering at the usual place in the valve, it has to traverse a large part of the volvula before making its exit from the brain.

In the drum (*Haplodonotus*) the brain as a whole is exceedingly short. This shortening has the effect to tilt the optic lobes and cerebellum at a considerable angle with the axis of the brain, and to roll the volvula into a spherical mass with three folds, which are packed closely into the cavity of the ventricle. The main lobe of the cerebellum also has a short cephalad spur.

In the cat-fish family the cerebellum, instead of projecting backward, is thrust cephalad, affording a very good and constant differential character. The few illustrations here cited are derived from a memoir about to appear in the *Journal of Comparative Neurology*, where a wider range of comparison and full illustration may be possible.

It will be noticed that in the above cases the gray or granular material is ental. It has been shown by Professor His that the nervous elements in the spinal cord and medulla arise from the ventricular epithelium. This the writer has show is also the case in the cerebellum, at least in reptiles and fishes. In the massive cerebellum of mammals we are struck by the difficulty which stands in the way of the carrying out of the same fundamental plan of structure. The active cells are separated from the epithelium by impervious masses of fibres. How, then, do these cells reach their destination? This important question we at first sought to solve by discovering in some embryonic stage an eversion similar to that described in reptiles. This proved to be a valuable clew, but not actually correct, though a tendency to revolve from behind forward is very pronounced in the cerebellum of birds, and is exhibited in the direction of the lobules of the cerebellum in marsupials. But, while there is not an actual eversion of the cerebellum in mammals, there is a time when a pouch from the lateral posterior walls of the fourth ventricle is formed. This divertacle envelops the cerebellum and meets its fellow of the opposite side. In a short time this sac flattens out, and both layers fuse with the ectal surface of the cerebellum, and constitute a temporary proliferating organ from which the cells are derived. These cells migrate to a point beneath the layer of Purkinje's cells, the origin of which seems to be also from the ventricular epithelium. Although this process has been observed only in rodentia there can be no doubt that it prevails in other groups of mammals. Although somewhat unexpected, this method is not unlike that which Professor His has described for the origin of the olives and related structures of the medulla. By this provision the increase of ectal surface through the convolutions of the cerebellum provides for the largest possible enlargement of the active centres with the most economical distribution of fibres.

This discovery may serve to enforce the value of a comparative method in approaching a complicated problem like the present one. C. L. HERRICK.

JOHN GILMER SPEED follows up his article in the September *Lippincott's* with a paper entitled "The Common Roads of Europe." He shows how far ahead of us the great nations of Europe are in the matter of roads and their administration and maintenance. Among other articles in the October number may be mentioned a paper by William Agnew Paton upon "The Lost 'Landfall' of Columbus."

ANTHROPOLOGY, PAST AND PRESENT.[1]

[Continued from p. 172.]

IT has been the custom to speak of the early Aryan, Semitic, and Turanian races as large swarms — as millions pouring from one country into another. It has been calculated that these early nomads would have required immense tracts of meadow land to keep their flocks, and that it was the search for new pastures that drove them, by an irresistible force, over the whole inhabitable earth.

This may have been so, but it may also have not been so. Anyhow, we have a right to suppose that, before there were millions of human beings, there were at first a few only. We have been told of late that there never was a first man; but we may be allowed to suppose, at all events, that there were at one time a few first men and a few first women. If, then, the mixture of blood by marriage and the mixture of language in peace or war took place at an early time, when the world was peopled by some individuals, or by some hundreds, or by some thousands only, think what the necessary result would have been. It has been calculated that it would only require six hundred years to populate the whole earth with the descendants of one couple, the first father being dolichocephalic and the first mother brachycephalic. They might, after a time, all choose to speak the Aryan language, but they could not choose their skulls, but would have to accept them from nature, whether dolichocephalic or brachycephalic.

Who, then, would dare at present to lift up a skull and say this skull must have spoken an Aryan language, or lift up a language and say this language must have been spoken by a dolichocephalic skull? Yet, though no serious student would any longer listen to such arguments, it takes a long time before theories that were maintained for a time by serious students, and were then surrendered by them, can be completely eradicated. I shall not touch to-day on the hackneyed question of the "home of the Aryans" except as a warning. There are two quite distinct questions concerning the home of the Aryans.

When students of philology speak of Aryans, they mean by Aryas nothing but people speaking an Aryan language. They affirm nothing about skulls, skins, hair, and all the rest. Arya with them means speakers of an Aryan language. While, on the contrary, students of physiology speak of dolichocephalic, orthognathic, euthycomic people, they speak of their physiological characteristics only, and affirm nothing whatever about language.

It is clear, therefore, that the home of the Aryas, in the proper sense of that word, can be determined by linguistic evidence only, while the home of a blue-eyed, blond-haired, long-skulled, fair-skinned people can be determined by physiological evidence only. Any kind of concession or compromise on either side is simply fatal, and has led to nothing but a promiscuous slaughter of innocents. Separate the two armies, and the whole physiological evidence collected by D'Omalius, D'Halloy, Latham, and their followers will not fill more than an octavo page; while the linguistic evidence collected by Benfey and his followers will not amount to more than a few words. Everything else is mere rhetoric.

The physiologist is grateful, no doubt, for any additional skull whose historical antecedents can be firmly established; the philologist is grateful for any additional word that can help to indicate the historical or geographical whereabouts of the unknown speakers of Aryan speech. On these points it is possible to argue. They alone have a really scientific value in the eyes of a scholar, because, if there is any difference of opinion on them, it is possible to come to an agreement. As soon, however, as we go beyond these mere matters of fact, which have been collected by real students, everything becomes at once mere vanity and vexation of spirit. I know the appeals that have been made for concessions and some kind of compromise between physiology and philology; but honest students know that on scientific subjects no compromise is admissible. With regard to the home of the Aryas, no honest philologist will allow himself to be driven one step beyond the statement that the unknown people who spoke Aryan languages were, at one time,

[1] Address before the section of Anthropology of the British Association for the Advancement of Science, at Cardiff, August, 1891, by Professor F. Max Müller, president of the section (Nature, Sept. 3).

and before their final separation, settled somewhere in Asia. That may seem very small comfort, but for the present it is all that we have a right to say. Even this must be taken with the limitations which, as all true scholars know, apply to speculations concerning what may have happened, say, five thousand or ten thousand years ago. As to the color of the skin, the hair, the eyes, of those unknown speakers of Aryan speech, the scholar says nothing; and when he speaks of their blood he knows that such a word can be taken in a metaphorical sense only. If we once step from the narrow domain of science into the vast wilderness of mere assertion, then it does not matter what we say. We may say, with Penka, that all Aryas are dolichocephalic, blue-eyed, and blond, or we may say, with Piétrement, that all Aryas are brachycephalic, with brown eyes and black hair (V. d.Gheyn, 1889, p. 26). There is no difference between the two assertions. They are both perfectly unmeaning. They are *vox et præterea nihil.*

My experiences during the last forty years have only served to confirm the opinion which I expressed forty years ago, that there ought to be a complete separation between philology and physiology. And yet, if I were asked whether such a divorce should now be made absolute, I should say, No. There have been so many unexpected discoveries of new facts, and so many surprising combinations of old facts, that we must always be prepared to hear some new evidence, if only that evidence is brought forward according to the rules which govern the court of true science. It may be that in time the classification of skulls, hair, eyes, and skin may be brought into harmony with the classification of language. We may even go so far as to admit, as a postulate, that the two must have run parallel, at least in the beginning of all things. But with the evidence before us at present, mere wrangling, mere iteration of exploded assertions, mere contradictions, will produce no effect on the true jury, which hardly ever consists of more than twelve trusty men, but with whom the final verdict rests. The very things that most catch the popular ear will by them be ruled out of court. But every single new word, common to all the Aryan languages, and telling of some climatic, geographical, historical, or physiological circumstance in the earliest life of the speakers of Aryan speech, will be truly welcome to philologists quite as much as a skull from an early geological stratum is to the physiologist, and both to the anthropologist, in the widest sense of that name.

But, if all this is so, if the alliance between philology and physiology has hitherto done nothing but mischief, what right, it may be asked, had I to accept the honor of presiding over this section of anthropology? If you will allow me to occupy your valuable time a little longer, I shall explain, as shortly as possible, why I thought that I, as a philologist, might do some small amount of good as president of the Anthropological Section.

In spite of all that I have said against the unholy alliance between physiology and philology, I have felt for years—and I believe I am now supported in my opinion by all competent anthropologists—that a knowledge of languages must be considered in future as a *sine quâ non* for every anthropologist.

Anthropology, as you know, has increased so rapidly that it seems to say now, "*Nihil humani a me alienum puto.*" So long as anthropology treated only of the anatomy of the human body, any surgeon might have become an excellent anthropologist. But now, when anthropology includes the study of the earliest thoughts of man, his customs, his laws, his traditions, his legends, his religions, ay, even his early philosophies, a student of anthropology without an accurate knowledge of languages, without the conscience of a scholar, is like a sailor without a compass.

No one disputes this with regard to nations who possess a literature. No one would listen to a man describing the peculiarities of the Greek, the Roman, the Jew, the Arab, the Chinese, without knowing their languages, and being capable of reading the masterworks of their literature. We know how often men who have devoted the whole of their life to the study, for instance, of Hebrew, differ, not only as to the meaning of certain words and passages, but as to the very character of the Jews. One authority states that the Jews, and not only the Jews, but all Semitic nations, were possessed of a monotheistic instinct. Another authority shows that all Semitic nations, not excluding the Jews, were polytheistic in their religion, and that the Jehovah of the Jews was not conceived at first as the Supreme Deity, but as a national god only, as the God of the Jews, who, according to the latest view, was originally a fetish or a totem, like all other Gods.

You know how widely classical scholars differ on the character of Greeks and Romans, on the meaning of their customs, the purpose of their religious ceremonies — nay, the very essence of their gods. And yet there was a time, not very long ago, when anthropologists would rely on the descriptions of casual travellers, who, after spending a few weeks, or even a few years, among tribes whose language was utterly unknown to them, gave the most marvellous accounts of their customs, their laws, and even their religion. It may be said that anybody can describe what he sees, even though unable to converse with the people. I say, decidedly no; and I am supported in this opinion by the most competent judges. Dr. Codrington, who has just published his excellent book on the "Melanesians: their Anthropology and Folk-Lore," spent twenty-four years among the Melanesians, learning their dialects, collecting their legends, and making a systematic study of their laws, customs, and superstitions. But what does he say in his preface? "I have felt the truth," he says, "of what Mr. Fison, late missionary in Fiji, has written: 'When a European has been living for two or three years among savages, he is sure to be fully convinced that he knows all about them; when he has been ten years or so amongst them, if he be an observant man, he knows that he knows very little about them, and so begins to learn.'"

How few of the books in which we trust with regard to the characteristic peculiarities of savage races have been written by men who have lived among them for ten or twenty years, and who have learnt their languages till they could speak them as well as the natives themselves.

It is no excuse to say that any traveller who has eyes to see and ears to hear can form a correct estimate of the doings and sayings of savage tribes. It is not so, and anthropologists know from sad experience that it is not so. Suppose a traveller came to a camp where he saw thousands of men and women dancing round the image of a young bull. Suppose that the dancers were all stark naked, that after a time they began to fight, and that at the end of their orgies there were three thousand corpses lying about weltering in their blood. Would not a casual traveller have described such savages as worse than the negroes of Dahomey? Yet these savages were really the Jews, the chosen people of God. The image was the golden calf, the priest was Aaron, and the chief who ordered the sacrifice was Moses. We may read the thirty-second chapter of Exodus in a very different sense. A traveller who could have conversed with Aaron and Moses might have understood the causes of the revolt and the necessity for the massacre. But without this power of interrogation and mutual explanation, no travellers, however graphic and amusing their stories may be, can be trusted; no statements of theirs can be used by the anthropologists for truly scientific purposes.

From the day when this fact was recognized by the highest authorities in anthropology, and was sanctioned by some at least of our anthropological, ethnological, and folk lore societies, a new epoch began, and philology received its right place as the handmaid of anthropology. The most important paragraph in our new charter was this, that in future no one is to be quoted or relied on as authority on the customs, traditions, and more particularly on the religious ideas of uncivilized races who has not acquired an acquaintance with their language sufficient to enable him to converse with them freely on these difficult subjects.

No one would object to this rule when we have to deal with civilized and literary nations. But the languages of Africa, America, Polynesia, and even Australia, are now being studied as formerly Greek, Latin, Hebrew, and Sanscrit only were studied. You have only to compare the promiscuous descriptions of the Hottentots in the works of the best ethnologists with the researches of a real Hottentot scholar like Dr. Hahn to see the advance that has been made. When we read the books of Bishop Callaway on the Zulu, of William Gill and Edward Tregear on the Polynesians, of Horatio Hale on some of the North American races, we feel at once that we are in safe hands, in the hands of real scholars. Even then we must, of course, remember that their knowledge of the languages cannot compare with that of Bentley, or Hermann, or Burnouf, or Ewald. Yet we feel that we cannot go altogether wrong in trusting to their guidance.

I venture to go even a step further, and I believe the time will come when no anthropologist will venture to write on anything concerning the inner life of man without having himself acquired a knowledge of the language in which that inner life finds its truest expression.

This may seem to be exacting too much, but you have only to look, for instance, at the descriptions given of the customs, the laws, the legends, and the religious convictions of the people of India about a hundred years ago, and before Sanscrit began to be studied, and you will be amazed at the utter caricature that is often given there of the intellectual state of the Brahmans compared with what we know of it now from their own literature.

And if that is the case with a people like the Indians, who are a civilized race, possessed of an ancient literature, and well within the focus of history for the last two thousand years, what can be expected in the case of really savage races? One can hardly trust one's eyes when one sees the evidence placed before us by men whose good faith can not be questioned, and who nevertheless contradict each other flatly on the most ordinary subjects. We owe to one of our secretaries, Mr. Roth, a most careful collection of all that has been said on the Tasmanians by eye-witnesses. Not the least valuable part of this collection is that it opens our eyes to the utter untrustworthiness of the evidence on which the anthropologist has so often had to rely. In an article on Mr. Roth's book in *Nature,* I tried to show that there is not one essential feature in the religion of the Tasmanians on which different authorities have not made assertions diametrically opposed to each other. Some say that the Tasmanians have no idea of a Supreme Being, no rites or ceremonies; others call their religion Dualism, a worship of good and evil spirits. Some maintain that they had deified the powers of nature, others that they were Devil-worshippers. Some declare their religion to be pure monotheism, combined with belief in the immortality of the soul, the efficacy of prayers and charms. Nay, even the most recent article of faith — the descent of man from some kind of animal — has received a religious sanction among the Tasmanians. For Mr. Horton, who is not given to joking, tells us that they believed "they were originally formed with tails, and without knee-joints, by a benevolent being, and that another descended from heaven, and, compassionating the sufferers, cut off their tails, and with grease softened their knees."

I would undertake to show that what applies to the descriptions given us of the now extinct race of the Tasmanians applies with equal force to the descriptions of almost all the savage races with whom anthropologists have to deal. In the case of large tribes, such as the inhabitants of Australia, the contradictory evidence may, no doubt, be accounted for by the fact that the observations were made in different localities. But the chief reason is always the same — ignorance of the language, and therefore want of sympathy and impossibility of mutual explanation and correction.

Let me, in conclusion, give you one of the most flagrant instances of how a whole race can be totally misrepresented by men ignorant of their language, and how these misrepresentations are at once removed if travellers acquire a knowledge of the language, and thus have not only eyes to see, but ears to hear, tongues to speak, and hearts to feel.

No race has been so cruelly maligned for centuries as the inhabitants of the Andaman Islands. An Arab writer of the ninth century states that their complexion was frightful, their hair frizzled, their countenance and eyes terrible, their feet very large, and almost a cubit in length, and that they go quite naked. Marco Polo (about 1285) declared that the inhabitants are no better than wild beasts, and he goes on to say: "I assure you all the men of this island of Angamanain have heads like dogs, and teeth and eyes likewise; in fact, in the face they are just like big mastiff dogs."

So long as no one could be found to study their language, there was no appeal from these libels. But when, after the Sepoy mutiny in 1856, it was necessary to find a habitation for a large number of convicts, the Andaman Islands, which had already served as a penal settlement on a smaller scale, became a large penal colony under English officers. The havoc that was wrought by this sudden contact between the Andaman Islanders and these civilized Indian convicts was terrible, and the end will probably be the same as in Tasmania — the native population will die out. Fortunately one of the English officers (Mr. Edward Horace Man) did not shrink from the trouble of learning the language spoken by these islanders, and, being a careful observer and perfectly trustworthy, he has given us some accounts of the Andaman aborigines which are real masterpieces of anthropological research. If these islanders must be swept away from the face of the earth, they will now, at all events, leave a good name behind them. Even their outward appearance seems to become different in the eyes of a sympathizing observer from what it was to casual travellers. They are, no doubt, a very small race, their average height being 4 feet 10¾ inches. But this is almost the only charge brought against them which Mr. Man has not been able to rebut. Their hair, he says, is fine, very closely curled, and frizzly. Their color is dark, but not absolutely black. Their features possess little of the most marked and coarser peculiarities of the negro type. The projecting jaws, the prominent thick lips, the broad and flattened nose of the genuine negro, are so softened down as scarcely to be recognized.

But let us now hear what Mr. Man has to tell us about the social, moral, and intellectual qualities of these so-called savages, who had been represented to us as cannibals; as ignorant of the existence of a deity; as knowing no marriage, except what by a bold euphemism has been called communal marriage; as unacquainted with fire; as no better than wild beasts, having heads, teeth, and eyes like dogs — being, in fact, like big mastiffs.

"Before the introduction into the islands of what is called European civilization, the inhabitants," Mr. Man writes, "lived in small villages, their dwellings built of branches and leaves of trees. They were ignorant of agriculture, and kept no poultry or domestic animals. Their pottery was hand-made, their clothing very scanty. They were expert swimmers and divers, and able to manufacture well-made dug-out canoes and outriggers. They were ignorant of metals, ignorant, we are told, of producing fire, though they kept a constant supply of burning and smouldering wood. They made use of shells for their tools, had stone hammers and anvils, bows and arrows, harpoons for killing turtle and fish. Such is the fertility of the island that they have abundance and variety of food all the year round. Their food was invariably cooked, they drank nothing but water, and they did not smoke. People may call this a savage life. I know many a starving laborer who would gladly exchange the benefits of European civilization for the blessings of such savagery."

These small islanders, who have always been represented by a certain class of anthropologists as the lowest stratum of humanity, need not fear comparison, so far as their social life is concerned, with races who are called civilized. So far from being addicted to what is called by the self-contradictory name of communal marriage, Mr. Man tells us that bigamy, polygamy, polyandry, and divorce are unknown to them, and that the marriage contract, so far from being regarded as a merely temporary contract, to be set aside on account of incompatibility of temper or other such causes, is never dissolved. Conjugal fidelity till death is not the exception but the rule, and matrimonial differences, which occur but rarely, are easily settled with or without the intervention of friends. One of the most striking features of their social relations is the marked equality and affection which exist between husband and wife; and the consideration and respect with which women are treated might, with advantage, be emulated by certain classes in our own land. As to cannibalism and infanticide, they are never practised by them.

It is easy to say that Mr. Man may be prejudiced in favor of these little savages, whose language he has been at so much pains to learn. Fortunately, however, all his statements have lately been confirmed by another authority, Colonel Cadell — the chief commissioner of these islands. He is a Victoria Cross man, and not likely to be given to over much sentimentality. Well, this is what he says of these fierce mastiffs, with feet a cubit in length:

"They are merry little people," he says. "One could not imagine how taking they were. Everyone who had to do with them fell in love with them [these fierce mastiffs]. Contact with civilization had not improved the morality of the natives, but in their natural state they were truthful and honest, generous and self-denying. He had watched them sitting over their fires cooking their evening meal, and it was quite pleasant to notice the absence of greed and the politeness with which they picked off the tit-bits and thrust them into each other's mouths. The forest and sea abundantly supplied their wants, and it was therefore not surprising that the attempts to induce them to take to cultivation had been quite unsuccessful, highly as they appreciated the rice and Indian corn which were occasionally supplied to them. All was grist that came to their mill in the shape of food. The forest supplied them with edible roots and fruits. Bats, rats, flying foxes, iguanas, sea-snakes, mollusks, wild pig, fish, turtle, and last, though not least, the larvæ of beetles, formed welcome additions to their larder. He remembered one morning landing by chance at an encampment of theirs, under the shade of a gigantic forest tree. On one fire was the shell of a turtle, acting as its own pot, in which was simmering the green fat delicious to more educated palates; on another its flesh was being broiled, together with some splendid fish; on a third a wild pig was being roasted, its drippings falling on wild yams, and a jar of honey stood close by, all delicacies fit for an alderman's table."

These are things which we might suppose anybody who has eyes to see, and who is not wilfully blind, might have observed. But when we come to traditions, laws, and particularly to religion, no one ought to be listened to as an authority who cannot converse with the natives. For a long time the Mincopies have been represented as without any religion, without even an idea of the Godhead. This opinion received the support of Sir John Lubbock, and has been often repeated without ever having been re-examined. As soon, however, as these Mincopies began to be studied more carefully, — more particularly as soon as some persons resident among them had acquired a knowledge of their language, and thereby a means of real communication, — their religion came out as clear as daylight. According to Mr. E. H. Man, they have a name for God — *Pûluga*. And how can a race be said to be without a knowledge of God if they have a name for God? Pûluga has a very mythological character. He has a stone house in the sky; he has a wife, whom he created himself, and from whom he has a large family, all except the eldest being girls. The mother is supposed to be green (the earth?), the daughters black; they are the spirits, called *Môrowin;* his son is called *Pïjchor*. He alone is permitted to live with his father, and to convey his orders to the Môrowin. But Pûluga was a moral character also. His appearance is like fire, though nowadays he has become invisible. He was never born, and is immortal. The whole world was created by him, except only the powers of evil. He is omniscient, knowing even the thoughts of the heart. He is angered by the commission of certain sins, — some very trivial, at least to our mind, — but he is pitiful to all who are in distress. He is the judge from whom each soul receives its sentence after death.

According to other authorities, some Andamanese look on the sun as the fountain of all that is good, the moon as a minor power; and they believe in a number of inferior spirits, — the spirits of the forest, the water, and the mountain, — as agents of the two higher powers. They believe in an evil spirit also, who seems to have been originally the spirit of the storm. Him they try to pacify by songs, or to frighten away with their arrows.

I suppose I need say no more to show how indispensable a study of language is to every student of anthropology. If anthropology is to maintain its high position as a real science, its alliance with linguistic studies cannot be too close. Its weakest points have always been those where it trusted to the statements of authorities ignorant of language and of the science of language. Its greatest triumphs have been achieved by men such as Dr. Hahn, Bishops Callaway and Colenso, Dr. W. Gill, and last, not least, Mr. Man, who have combined the minute accuracy of the scholar with the comprehensive grasp of the anthropologist, and were thus enabled to use the key of language to unlock the perplexities of savage customs, savage laws and legends, and, particularly, of savage religions and mythologies. If this alliance between anthropology and philology becomes real, then, and then only, may we hope to see Bunsen's prophecy fulfilled, that anthropology will become the highest branch of the science for which this British Association is instituted.

Allow me in conclusion once more to quote some prophetic words from the address which Bunsen delivered before our section in 1847:

"If man is the apex of the creation, it seems right, on the one side, that a historical inquiry into its origin and development should never be allowed to sever itself from the general body of natural science, and in particular from physiology. But, on the other side, if man is the apex of the creation, if he is the end to which all organic formations tend from the very beginning, if man is at once the mystery and the key of natural science, if that is the only view of natural science worthy of our age, then ethnological philology (I should prefer to say anthropology), once established on principles as clear as the physiological are, is the highest branch of that science for the advancement of which this association is instituted. It is not an appendix to physiology or to anything else; but its object is, on the contrary, capable of becoming the end and goal of the labors and transactions of a scientific association."

Much has been achieved by anthropology to justify these hopes and fulfil the prophecies of my old friend Bunsen. Few men live to see the fulfilment of their own prophecies, but they leave disciples whose duty it is to keep their memory alive, and thus to preserve that vital continuity of human knowledge which alone enables us to see in the advancement of all science the historical evolution of eternal truth.

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.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

Communication with Other Planets.

I NOTICE a letter from Sir Robert Ball with reference to the recent bequest of a French lady of 20,000 francs for a method of signalling to other planets. He enumerates different methods, but he does not speak of one method which I have never seen discussed but which seems to me worthy of mention. On a moonless clear night the electric and gas lights over such a large territory as New York and its suburbs must present the appearance to a spectator in Mars of a spot of light on the dark side of our globe If, now, on such a night, from the middle of some large dark area, for example, the Atlantic Ocean, brilliant flashes of light be regularly sent forth in certain forms, there would be a chance of its being interpreted by the inhabitants of other spheres, and they might thereby be induced to signal us in return.

But there is a bare possibility of direct communication by taking advantage of the meteor currents in the great ocean of space in which we move. If on breaking open a meteorite we should find a chipped flint or other instrument, we should conclude that the portion of space from which it came had intelligent inhabitants. If, now, we can by the aid of modern explosives project into some meteor shoal a ball of iron containing at its center some object of human design, the ball might ultimately come to some other planet and be found by its inhabitants. Such a procedure would be analogous to casting a bottle inclosing a message upon the ocean to be wafted by the currents to some intelligent eye.

The wild schemes of one generation are often achieved in the next. Jules Verne's "Around the World in Eighty Days" and "Twenty Thousand Leagues under the Sea" have been in a measure realized, and possibly his "Voyage to the Moon" is the next romance to be realized in some form. An initial velocity of seven miles a second would be required to project a body beyond the earth's attraction, and it is not too much to hope that this will soon be attainable at the present rate of progress in the science of explosives. A projectile sent from the earth would have considerable value as a direct astronomical experiment on meteorites, even if it should fail in bringing tidings from another planet.

HIRAM M. STANLEY.

Lake Forest, Ill., Sept. 26.

The Man of the Future.

MAN being, zoologically, the highest organism known, the question of his further evolution and its probable direction is one which is naturally of interest to the student of anthropology. Is the development of a higher species possible or probable?

In order to even partially answer this question we must first consider what would constitute perfection or an approach to it. We are met at the very threshold of the problem by the fact, apparent on every hand, that the human product of our present civilization is, in the vast majority of instances, a very unequally developed organism, physically and mentally: an asymmetrical creature, the victim, so to speak, of specialism of one kind or another; it may be of environment or of occupation, usually of both. Hence the necessarily great diversity of view as to what would be improvement in the race.

It is a self-evident fact that improvement of the individual means, in the long run, advancement of the race; but when we ask what constitutes individual improvement, we receive one answer from the sociologist, another from the political economist, a third from the athlete or artist, and still a different reply from the philosopher.

That an easily-governed and equably-tempered people are not necessarily of a high type of humanity is evident from the experience of China, where a population of 350,000,000 is governed by a standing army of only 80,000 and the simplest police regulations, — a state of affairs unparalleled in the history of the so-called civilized nations. The perfection of their civil service and the insignificant expense of state officials are also said to be marvellous in the light of our experience. This state of affairs has been attributed to the perfection of their social training system, but it seems to the writer also allowable to suppose that many centuries of low diet, with overcrowding and mental subjection, have largely eliminated that spirit of restlessness and opposition to authority so characteristic of western peoples.

The ideas of the gymnast or exponent of physical culture, and of the purely intellectual sophist, are equally at fault in the solution of our question of improvement of the race; for it is evident to all medical men, at least, that powerful muscles may be a source of vital weakness to their possessor by inducing heart strain, or by overtaxing the eliminative capacity of the kidneys and other depurative organs, in the disposal of the results, the ashes so to speak, of muscular combustion. And, again, even a powerful brain may be menaced in its integrity by a weak or diseased blood-vessel incapable of withstanding the pressure caused by high functional activity.

The zoologist, therefore, sees the true strength of the individual, the race, and the species in (1) their plasticity, i.e., adaptability or capacity for modification in response to changes of environment, provided this plasticity be not the cause of localized weaknesses; and (2) equilibrium of development, organic balance, so to speak, between the component parts of the animal.

The question has been asked, Would not the development of wings or other additional organs be an improvement in the species? The reply to this, on zoological principles, would be No. The addition of wings, for instance, would be a retrogression to a lower type; and if the wings were feathered, a still further retrogression. We must conclude, then, that wings are incompatible with progress, zoologically considered, all visions of angels to the contrary notwithstanding.

In fact it is difficult to foresee any structural change of plan that would be an improvement under our present environment.

While, therefore, we may anticipate an increase in the average perfection of parts, and consequently a more harmonious development of man's present plan of structure, we cannot rationally look for any radical change in the plan itself. Hence we may conclude, upon purely theoretical grounds, as well as zoological experience, that under present conditions man is, in his plan of structure, the highest type of animal that can be produced; and while this may seem to coincide with the philosophy of the fatalist, "whatever is, is right," it is nevertheless true.

Improvement in organic balance or correlation of organs, therefore, is the chief direction of advance possible, and this improvement may be favored by the avoidance of excessive specialism in environment and occupation, by which certain organs are overdeveloped, while others are dwarfed from disuse.

The ideal man is the perfectly balanced man, physically and mentally; neither an athlete, an intellectual giant, nor a zoological monstrosity, but a being harmoniously developed in all parts.

It may be objected that such an organism would, like the "one-hoss shay" of Dr. Holmes, go to pieces all at once. But would not this imply a useful capacity and activity up to a good old age, of which we have striking examples in the lives of Audubon, Jefferson, and Darwin, and be vastly preferable to a break at forty from some one weak organ?

The maxim, "A chain is only as strong as its weakest link," applies here as forcibly as it does in mechanics.

DR. F. W. LANGDON.

Cincinnati, O., Sept. 15.

BOOK-REVIEWS.

A History of Chemistry. By ERNST VON MEYER. Translated by George M'Gowan. New York and London, Macmillan. 8°. $4.50.

THERE have not been many histories of chemistry written, the best known being probably that of Kopp, which began to appear nearly fifty years ago. The same is true of physics, the only one that now occurs to us being that of Poggendorf, yet it has often seemed that it would be well for the student to be informed of the way by which the present state of science has been reached, yet it is but rarely that such information is imparted in lectures or in the class-room.

One reason for this may be in the worthlessness of what has gone before, which is strongly brought out in our author's treatment of alchemy. The benefits which accrued to chemistry during the centuries which were occupied by alchemists in the attempt to turn the baser metals into gold he estimates as very slight. It was but seldom that a discovery of technical value, like that of the making of porcelain, sprang from alchemistic work. On the other hand, positive harm was done by the tendency to mysticism among many of the workers, which resulted frequently in deliberate fraud.

As man seems really to care first for wealth and then for health, — at least he will give up the latter in pursuit of the former, — so after the attempt to gain riches through chemical knowledge had proved futile, attention was turned by investigators — and these of a higher class of intelligence than the earlier alchemists — to a development of the knowledge of drugs and their action on the human system, and to this period a chapter is devoted.

One phenomenon which was evidently chemical in its nature — combustion — had always interested chemists, and gave rise to the phlogiston theory, which held sway from soon after the death of Boyle till the discovery of oxygen in 1774. This theoretical view of combustion had a great influence on the progress in the accumulation of chemical truths, and it may be that here again some would urge that little attention need now be paid to these antiquated doctrines. But it may be well for the wisest of the physicists and chemists of the present day to occasionally have it pointed out to them how essentially false doctrines can maintain themselves for considerable periods when once they have received the endorsement of men wise in their day and generation.

Chemistry, as we know it, came into full possession of its faculties with the beginning of the use of the balance and the discovery of oxygen. The systematization of the facts as they were discovered was based, first, on the atomic theory of Dalton, and later on the doctrine of valency as developed during the past thirty years. All this development of the science is described historically in the early chapters of the book before us.

The closing chapter is devoted to a special history of the various branches of chemistry, from Lavoisier to the present day. In this chapter are treated the history of analytical chemistry, and of pure chemistry, inorganic and organic, which naturally leads to a consideration of thermo-chemistry or of physical chemistry in general. Technical chemistry is not neglected, nor are physiological and agricultural, which offer as difficult problems as any in the whole science. A section of interest is devoted to the methods of chemical instruction, which are attracting much attention in Great Britain and Germany.

We believe Meyer's "History of Chemistry," standing as it does alone, should be much used by teachers and students.

A Manual of the Steam Engine. Part I.: Structure and Theory. By Robert H. Thurston. New York, Wiley. 8°. $7.50.

It has been a common slur at the thermo-organic theory of heat-engines that it has led to little of the improvement in their construction. It is well known that the thermo-dynamics of the steam-engine was not understood, or at least generally recognized, till the best part of a century had passed after the first introduction of the engine as a practical motive power. But even then the theory applied only to an ideal engine — an engine consisting of a few diagramatic lines called a "hot body," a "cold body," etc., and known as the Carnot engine. That this theoretical explanation of the working of the heat engine is of the greatest interest, and has certainly aided materially in clearing engineers' ideas as to the possibilities of the heat-engine, cannot be denied; but there are so many differences between the Carnot engine and the steam-engine of practice that the improvement of the latter has been forced to depend on the "rule of thumb" for guidance.

Professor Thurston, in this book, makes an attempt to carry the theory forward a step and put it in such shape as to be applicable to the real engine. He does not maintain that this can as yet be done with perfect satisfaction, but only that sufficient knowledge of the various wastes of heat has been obtained to justify this treatise. The subject is still obscure, but it is believed that the provisional theory and purposed processes of computation will aid the engineer materially in his endeavor to anticipate the performance of any new engine, the design of which may be hand.

Cotterill's "The Steam-Engine considered as a Heat-Engine" was perhaps an earlier attempt in the same direction, and with the progress of experimental work at the numerous technical institutions the world over, modifications in Thurston's treatment must be called for.

This first part covers the structure and theory of the steam-engine; the second part will be devoted to the design, construction, and operation.

AMONG THE PUBLISHERS.

A series of eight excellent views of the Leland Stanford, jun., University at Palo Alto, Cal., drawn by Hughson Hawley, is given in *Harper's Weekly* for Oct. 3.

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Brooklyn Institute, Third Year-Book of the (1890–91). Brooklyn, Eagle Pr. 232 p. 12°.
Merrill, G. P. Stones for Building and Decoration. New York, Wiley. 453 p. 8°. $5.
Schuchhardt, C. Schliemann's Excavations: an Archæological and Historical Study. New York, Macmillan. 363 p. 8°. $4.
Smith, E. F., and Keller, H. F. Experiments Arranged for Students in General Chemistry. 2d ed. Philadelphia, Blakiston. 56 p. 8°.
Solms-Laubach, H. Graf zu, Fossil Botany. New York, Macmillan. 401 p. 8°. $4 50.
Thorne, R. T. Diphtheria: Its Natural History and Prevention. London and New York, Macmillan. 266 p. 12°. $2.

fessional and amateur; "The Principles of Perspective as Applied to Model-Drawing and Sketching from Nature," with 32 plates and other illustrations, by George Trobridge, head master government school of art, Belfast, second edition, revised and enlarged.

— Messrs. Whittaker & Co. announce the following books: In Whittaker's Library of Popular Science — "Light," by Sir H. Trueman Wood, secretary of the Society of Arts, 86 illustrations, containing chapters on the nature of light, reflection, refraction, color, and the spectrum, lenses, optical instruments, etc.; "The Plant World: its Past, Present, and Future," by George Massee, with numerous illustrations. In Whittaker's Specialist's Series — Professor Oliver Lodge's work upon "Lightning Conductors and Lightning Guards;" "The Alkali Maker's Hand-book," by Professor Dr. George Lunge and Dr. F. Hurter, a new, revised, and enlarged edition; "Electric Light Cables and the Distribution of Electricity," by Stuart A. Russell; "The Artificial Production of Cold," by H. G. Harris; "The Dynamo," by C. C. Hawkins and J. Wallis; "The Drainage of Habitable Buildings," by W. Lee Beardmore, member of the council and honorary secretary of the Civil and Mechanical Engineers' Society; a fourth revised and enlarged edition of "The Working and Management of an English Railway," by G. Findlay, general manager of the London and North-Western Railway; "The Working and Management of an Atlantic Liner; with a Retrospect of the Trade," by A. J. Maginnis, recently assistant superintendent of the White Star Line. In Whittaker's Library of Arts, Sciences, Manufactures, and Industries — "A First Book of Electricity and Magnetism," by W. Perren Maycock; "The Practical Telephone Hand-book and Guide to Telephonic Exchange," by J. Poole, Whitworth scholar, 1875, late chief electrician to the Lancashire and Cheshire Telephone Exchange Co., with 227 illustrations; "The Optics of Photography and Photographic Lenses," by J. Traill Taylor, editor of the *British Journal of Photography;* "The Art and Craft of Cabinet-making," by D. Denning, with upwards of 200 illustrations.

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Sportsmen and ornithologists will be interested in the list of Labrador birds by Mr. L. W. Turner, which has been kindly revised and brought down to date by Dr. J. A. Allen. Dr. S H. Scudder has contributed the list of butterflies, and Prof. John Macoun, of Ottawa, Canada, has prepared the list of Labrador plants.

Much pains has been taken to render the bibliography complete, and the author is indebted to Dr. Franz Boas and others for several titles and important suggestions; and it is hoped that this feature of the book will recommend it to collectors of *Americana*.

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NEW YORK, OCTOBER 9, 1891.

BURIAL CUSTOMS OF THE HURONS.[1]

THE region to which I desire to carry my audience is one full of historic interest, made doubly so from the fact that Parkman has so frequently referred to this part of North America in his valuable writings, and also from the fact that the early Jesuits first commenced their missionary labors in this district No matter how one may view or in what light one may regard the work which the Jesuits had undertaken in Christianizing the aborigines, we cannot but admire their great zeal, endurance, and indomitable courage; and students in quest of knowledge concerning the traits of the Indians are deeply indebted to these missionaries for their keen observations and copious notes, which gave us such an insight into the aboriginal manners and customs. The Huron Indians inhabited what is now known as the County of Simcoe, in the Province of Ontario, Canada, situated between two large bodies of water: on the north lies the Georgian Bay, with its 30,000 islands, and on the south the clear crystal waters of Lake Simcoe. The locality was in every way an ideal one for an aboriginal site. The country was well wooded, game was plentiful, large and small lakes abounded, which not only gave a plentiful supply of pure water, but were also full of fish, while small streams flowed in various directions. With such favorable surroundings it is not surprising that the Hurons had remained in the same locality for centuries, and had it not been for their implacable foes, the Iroquois, they might possibly be there yet. But in 1649 their dreaded enemy descended upon them and slaughtered Indian and Jesuit alike, and the few who escaped sought refuge in the islands of Georgian Bay, from whence shortly afterwards they removed to Lorette, near Quebec, where the remnants of that once great tribe can be now found and are known by the name of Wyandots. The County of Simcoe has proved a most prolific field for the archæologist to work in, and for fifteen years I have devoted much time to the examination of earthworks and to the collecting of relics. I have secured some four thousand objects in stone, shell, bone, pottery, and copper. Many of the specimens deserve to be ranked amongst the finest of the so-called Neolithic period. As reports of the various forts and earthworks which I have surveyed have appeared frequently in public print, I shall not now refer to them; I desire simply to make a few remarks on the burial customs of the Hurons.

Their places of sepulture are of three kinds, — the ossuaries (or depositories of human bones), single graves, and mounds. The ossuaries contain the remains of from a few to several thousand bodies, and it is principally in these that specimens are found. I might say that I opened one of these large pits in South Orillia township and dug through human bones nearly ten feet deep. In order to account for the interment in such large numbers in one spot, it is necessary to explain the custom which resulted in such a practice. The "Feast of the Dead" was one of the Indians' most solemn and religious rites; when an Indian died, it was the custom from time to time to erect a rough stage, place the body on top, and every eight or ten years collect the remains so placed, scrape the flesh from the recent dead, and bury them in one large hole. The functionaries on whom the duty of scraping devolved were denominated "bone-pickers." As the bodies were cast in promiscuously, it is very difficult to find perfect crania among the bones so deposited. From thirty of these ossuaries I have only succeeded in securing about forty perfect ones. One skull was particularly interesting from the fact that it had been broken through in three separate places, and yet the Indian had lived for years, apparently, as the wounds were completely healed. When one has seen an ossuary it is easy to recognize them whenever one may find them, owing to the circular depression of the surface, which is traceable to the decay of the bones. One singular circumstance in connection with these ossuaries is worthy of mention, and it is that they either contain many relics or are entirely devoid of them.

With regard to the single graves, of which I have opened some 350, I do not suppose there were more than fifty which contained anything but human bones. In certain cases the bodies were in a sitting posture, but usually they were not placed in any particular position. The sepulchral mounds in the United States are usually very large, but the Huron mounds are only three to four feet high and about sixty feet in circumference, and of no regular shape. These contain from six to twelve bodies, placed some two feet apart; differences in the shape of the crania are observable in many of these sepuchral places. This might be accounted for by the practice of attaching prisoners of war to the several tribes, and also by that of occasionally uniting the remains of a shattered tribe with a tribe that had conquered. There is certainly a difference in crania which have been found in the same locality, so that if we were to find the brachycephalic and the dolichocephalic types under the same mound we should in this way be able to account for such an occurrence. Besides, intermarriage among members of the same clan was forbidden by some tribes, so that if a member of the Turtle Clan aspired to the paternity of a Romulus or Remus it behooved him to seek the affections of a lady from some other clan than his own. In a pamphlet sent me by its author, Mr. Lucien Carr of the Peabody Museum, Boston, Mr. Carr gives the mean measurement of sixty-seven crania taken from stone graves in Tennessee: he found five dolichocephalic, eighteen orthocephalic, twenty-nine brachycephalic, and fifteen much flattened. Mr. Carr observes that the measurement of the above mentioned crania (exclusively of the flattened heads) indicates that they belong to the two extremes of classification. The measurements of Mr. Carr correspond with my own experience, for I have observed a considerable diversity in the crania of the ossuaries, mounds, and single graves. The dolichocephalic type is characteristic of the eastern tribes. Crania which have undergone compression when young have a conformation which is as manifest internally as it is by the exterior. It is by many believed that the burial of articles with the dead was a religious act, but

[1] Notes of a paper read before the American Association for the Advancement of Science, at Washington, by Charles A. Hirschfelder, U. S. Vice Consul, Toronto, Canada.

my own observations do not lead me to think that it was necessarily so. We know that the Indians lived strictly up to their belief, and if it had been an act of religion to thus bury articles, I maintain that in each and every grave some articles would be found. But, as I have pointed out, the single graves do not, in many cases, contain anything; and where the large ossuaries have been carefully examined, some of them have not contained a pipe or bead, while a single ossuary in close proximity might contain a thousand articles. Now, my theory is this, if one of these "feasts of the dead" should occur during a propitious season, many articles could be spared, but if a famine stared the Indians in the face, which frequently happened, they would be too poor to spare articles, and it appears to me that the act of burial was not one of religion but an act of respect.

The valuable paper by Mr. Wilson on jade articles, and the theory advanced by Professor Putnam that possibly the jade for making these objects came from China, is one worthy of close investigation, but must at present be referred to with much caution. That the aborigines traded over a vast extent of country is evidenced by the fact that we find southern shells, *pyrula perversa* and other such species, in our most northern graves, while in the South copper implements are found which show by their laminated structure that they are of aboriginal workmanship, and the material is identified as coming from Lake Superior from the large amount of silver it contains.

SPONGE TRADE OF THE BAHAMAS.

A RECENT report by United States Consul McLain of Nassau contains much interesting information about the sponge trade of the Bahama Islands. The vessels used in the sponge trade in those islands are small craft, varying in size from five to twenty-five tons burden, and are either schooner or sloop rigged. They are all built in local shipyards, and their construction and repairs constitute an important business in itself. The frames are generally made of Madeira wood, a hard, tough wood of native growth, the planking and other material being of yellow pine imported from the Southern States. Each vessel carries two or three small open row or scull boats, with a crew of from eight to twelve men. These vessels have an average life of from sixteen to twenty years, undergoing, of course, occasional repairs. It is thought that there are from four hundred and fifty to five hundred of these vessels.

The number of persons engaged in the business of gathering sponges in the Bahamas, handling them, and preparing them in various stages for market, is from five to six thousand, all of whom, except the shipowners, brokers, and shippers, are colored people. Hands employed in clipping, washing, packing, and preparing finally for shipment abroad, get from fifty to seventy five cents per day of ten hours. The amount earned by the men who go fishing for sponges cannot be given, as their pay depends entirely on the number of sponges obtained. The owner of the vessel fits her out at his own expense, and the profits of the voyage are divided up in shares among the owner, the master, and the men. They are never hired by the month, nor do they ever get specified wages. The most that can be said is that the men make a tolerable living, and the sponge fisherman who earns over three hundred dollars a year is the exception. The owners of the vessels, as a rule, have their own shops, from which the vessels are fitted out, and on supplies thus furnished the owner makes a profit in addition to others The shipowners, generally speaking, find considerable profit in the business, whilst the fishermen, if not able to lay up any money from the pursuit, are yet enabled to rely upon it for a moderate living.

The method of gathering sponges is by means of iron hooks attached to long poles. By using a water-glass the fisherman can readily discover the sponges at the bottom, and then with his pole and hook he will bring up those he may select as fit for his purpose, leaving the smaller ones untouched. Some sponges adhere firmly to the bed of the sea, while others are not attached at all, these latter being known as "rollers." About ten years ago an attempt was made to introduce dredges; but it was found that their use was likely to ruin the beds, because in passing over the bottom they dislodged and brought up not only the good sponges, but the young and unsalable ones as well, killing the spawn and working great mischief. The ordinary fishermen also made an outcry, declaring that the use of dredges interfered with their rights. An act was passed by the legislature forbidding the use of dredges, and only the pole and hook are now used.

When the sponge-field is reached the vessel anchors, and the men, putting off in the small open boats, do the fishing in the manner above indicated, returning to the vessel before nightfall with their catch. The sponges, when brought to the vessel, are at once spread upon the deck, and are left exposed to the sun for several days, during which time the animal matter that covers the sponge gradually dies. This is a black, gelatinous substance of a very low order of marine life, which during the process of decay emits a most objectionable odor. The vessels visit what is called the "kraal" once a week to land the load from the deck. The kraal is an inclosed pen, fenced in by sticks of wood so as to allow a free circulation of water through it, usually built in a sheltered and shallow bay or cove, on one of the cays near by. The sponges are placed in the kraal and left to be soaked and washed by the action of the water from four to six days, when they are taken out and beaten with sticks until the decayed covering is entirely removed. Having been subjected to this course of exposure, soaking, beating, and washing, the sponges are quite clean, and are taken on board the vessel, packed away in the hold, conveyed to Nassau, and in this condition are sold in the local market.

The average catch per trip cannot be stated, as the cargoes vary greatly in size and value. Of the larger sponges a catch of five thousand, or of the smaller ones seven thousand five hundred, would be considered a fair lot. Occasionally a cargo of from twelve to fifteen thousand large sponges has been brought in, but this success is exceptional. The vessels are provisioned and fitted out, as a rule, for a voyage of about six weeks, and generally from seven to eight voyages are made per annum.

There cannot be said to be any season for sponge-gathering, as it goes on all through the year. A number of vessels are often laid up, however, during August and September, the men being timid and afraid of hurricanes during that period. Of course the quieter the weather and smoother the sea, the better the chances are for making a good catch, as nearly all the work is done in small open boats from ten to twelve feet in length. Much also depends upon the energy and the industry of the crew, and there is luck in finding a locality where the sponges are valuable and abundant.

As to the length of time required for sponges to grow to good marketable size little definite can be said; none of the fishermen are able to tell, though many volunteer opinions that differ widely. It is a matter to be determined by future scientific investigation, but it is believed it will be found that a healthy sponge will reach a marketable size in from twelve to eighteen months under ordinary conditions of growth. No attempts have been made, worthy of mention, to cultivate the sponge in these waters.

The sponges are prepared for export in the following manner. After being bought in the local market they are carted to the shipping yard of the purchaser, where they are cut and trimmed into proper shapes and sizes; they are then washed and thoroughly dried, being generally spread in the sun for that purpose upon canvas or old sails; next they are assorted according to varieties and grades, and then packed by means of hand presses into bales weighing from twenty to a hundred and fifty pounds. Sometimes the sponges are bleached by being passed through a solution of white lime and water, so weak as not to injure the fibre of the sponge. The consul does not know of any process resorted to for coloring the sponges, and few, indeed, are even bleached at present.

When offered for sale in the local market, the sponges are either piled up loose or made into strands or beads of from two to ten sponges each. The best sponges are usually made into strings of from eight to ten sponges each, the price averaging about sixty cents per string. Others are generally sold in lots not strung. The buyer, however, is not guided in his purchase by the number of sponges on a string, but by what a certain lot will weigh, and the weight is never given, but the buyer must estimate it. Hence practical experience is needed in the purchasing of the sponges.

Sponges are offered for sale on five days of the week at the sponge exchange. They are landed from the vessels, and each cargo is piled up by itself. The weight is entirely unknown. The buyers examine the lots, and each man hands in a private tender, in writing, for the lot, and it is awarded, on opening the tenders, to the highest bidder. A successful buyer must be able to judge correctly by his eye and experience just how many pounds of good sponges he will be able to get out of a given lot when it has been carefully worked up. Nearly all the sponges are bought by resident agents, who buy for New York, London, and Paris houses, shipping the goods to their principals. A few merchants handle sponges on their own account.

Along the southern coast of Florida the sponge business is in a flourishing condition, and has been for years, with its headquarters at Key West, and hundreds of the people of that vicinity are engaged all the time in gathering, curing, and shipping sponges. Many natives of the Bahamas visit Florida from time to time and find employment in the sponge business; though all the crews necessary to introduce the business on the Gulf coast of Florida, men well versed in the industry, can be obtained easily at Key West, without the least necessity of importing labor into the State from the Bahamas. It is said that the sponges growing along the Florida coast are much superior to the sponges of the Bahamas.

THE KHEVSURS OF THE CAUCASUS.

Monsieur V. Dingelstedt has published some notes on this singular people in *Le Globe* (tome xxx. No. 2), an abstract of which appears in the *Scottish Geographical Magazine* for September. The name is derived from the Georgian word *Khévi*, signifying a mountain gorge, and is unknown among the people to whom it is applied. They call themselves after the different localities they inhabit not by any collective name. Their country is situated to the east of the Pass of the Cross, on both slopes of the central chain of the Caucasus, to the west and north-west of the mountain Borbalo, and has an area of about 570 square miles. Its mean altitude is over 6,500 feet, and it contains peaks rising above the limit of eternal snow, which, in the central part of the Caucasus, is at an elevation of 10,600 feet. About seven thousand persons inhabit this wild region, in a bleak climate, where the cultivable soil is of small extent and the vegetation poor.

In the summer the Khevsurs feed cattle and sheep on the rich grass which springs up on the mountain slopes, but in the winter forage is difficult to obtain, and the animals and their owners often succumb to famine. The Khevsurs, in contrast to the other mountaineers of the Caucasus, are plain in appearance, of rather short stature, and with large hands and feet, though they are muscular and agile. A great variety is observable in the color of their eyes and hair, their stature, and even in the form of their skulls, and this diversity may be ascribed to a mixture of race. Their original ancestors were probably Georgians, who, some time before the twelfth century, took refuge in the mountains. These were probably joined by men of other races, who, for various reasons were obliged to fly from their native lands, or were attracted by the life of brigandage which the Khevsurs led up to recent times. Their Georgian ancestors had reached a fairly high standard of civilization, but in their savage solitudes the Khevsurs have relapsed into semi-barbarism, and have now a fierce and defiant expression. They wear coats of mail, brassarts, and helmets, like cavaliers of the Middle Ages. They live in communities consisting of one or several villages, under the nominal authority of a chief called a *Khevisberi*. These villages are grouped around some spot supposed to be sacred to a saint, and this religious bond has taken the place of the old tribal unity.

The Chevsurs have a vague belief in one God, but they never address him in prayer, and their rites consist in sacrifices and invocations to various saints, Christian and pagan, among which Saint George is held in high repute. Most of the work falls on the women, while the men spend their time in idleness. Marriages are concluded either with Christian or pagan rites. The wife brings with her a dowry of cattle and a trousseau. The offspring of the cattle belong to the house of the husband, but the original herd is the private property of the wife, and any loss must be made good by the husband. The wife has no share in the property of her husband at his decease. It is divided among his male heirs, and, in default of these, goes to the community. So, too, the wife's property is divided among her sons, her trousseau only being left to her daughters.

Monogamy is the rule, but custom permits a man to repudiate his wife when she grows old, or if she bears no children, and to take another, provided that he gives an indemnity of five or six cows to the parents of the former. In other cases divorce is easily effected, but is seldom resorted to. The dead are buried in vast caves. They are dressed in coats of mail, and sometimes musical instruments are placed in their hands. Festivals are held in their honor five times, or, in the case of poor families, twice a year, when there is a lavish display of hospitality, and quarrels frequently take place.

NOTES AND NEWS.

In the last paragraph on page 192 of *Science* for Oct. 2, "An initial velocity of seven miles a second," should read, "An initial velocity of six miles a second."

— Amos E. Woodward, late assistant geologist on the Geological Survey of Missouri, died of pneumonia at Castle, Mont., in the last week of September. During his connection with the Missouri survey, Mr. Woodward's special subject was the mineral waters of the State, though he also conducted much other work in the laboratory. He was a painstaking, ambitious, and most industrious worker, and was held in high esteem by those who knew him.

— The flesh-colored, hydrated manganese sulphide which is obtained by the addition of ammonium sulphide to a solution of manganize chloride, on standing, or more rapidly on boiling with water, changes color to green. This green sulphide when washed and dried yields a powder of the same color, which is also unstable, being oxidized by mere exposure to air. It is, however, according to P. de Clermont and H. Guiot (*Mining and Engineering Journ.*), rendered permanent by removing its water of hydration, which is effected by heating it moderately in a current of hydrogen sulphide, carbon dioxide, or ammonia. Thus prepared it is suitable for application in paper staining, etc.

— Dr. L. Webster Fox is of opinion, says *Nature*, that savage races possess the perception of color to a greater degree than do civilized races. In a lecture lately delivered before the Franklin Institute, Philadelphia, he stated that he had just concluded an examination of 250 Indian children, of whom 100 were boys. Had he selected 100 white boys from various parts of the United States, he would have found at least five of them color-blind: among the Indian boys he did not discover a single case of color-blindness. Some years ago he examined 250 Indian boys, and found two color-blind, a very low percentage when compared with the whites. Among the Indian girls he did not find any. Considering that only two females in every 1,000 among whites are color-blind, he does not think it surprising that he did not find any examples among the Indian girls.

— Some time ago the Field Naturalists' Club of Victoria organized an excursion to the Kent group of islands, the object being to collect specimens, and to determine whether the group is most nearly related with Victoria, to which it is closest geographically, or with Tasmania. At the annual *conversazione* of the club, held recently, as we learn from *Nature*, Mr. C. A. Topp, the retiring president, referred to the results of the expedition. The bulk of the fauna and flora were found to be common to Victoria and Tasmania, but there were six or seven varieties of birds peculiar to Tasmania to two peculiar to Victoria. The conclusion was that the islands had been separated from Tasmania after that island was disjoined from the mainland. Among the plants, several forms were found varying somewhat from the typical forms of the same species on the mainland; while it was interesting to find that the arboreal short-eared opossum had changed his habits so far as to feed on the leaves of the eucalypt, and to keep to the ground.

— M. de Groot of the Dutch Colonial Government in the East Indies has made an interesting communication to the Geographical Society of Amsterdam on the subject of Chinese emigration, which is briefly quoted in the Proceedings of the Royal Geographical Society for September. According to the writer, the causes of this emigration are not to be found in the excess of population, but simply in the poverty of the soil of the provinces whence these emigrants come. It is the bare, mountainous valleys of the eastern part of China which furnish the emigrants to the English, Spanish, and Dutch colonies; to California, Australia, and especially to Indo-China and Cochin-China. The prevailing formation of the ground in their native regions is granitic; the soil yields hardly anything, and the rainfall is slight. Potatoes and vegetables of very bad quality are the only food that can be extracted from the earth. In some favored spots a little rice, but of a poor description, can be grown. Another cause of the emigration is disafforestation. Wood is very scarce, and consequently very dear. Vegetation being almost entirely plucked up, the formation of a new layer of humus is absolutely impossible. The population of these regions is therefore compelled to seek subsistence in other countries. The writer is of opinion that as soon as China sets herself in earnest to construct a network of railways and to carry out other great works, the stream of emigration, which is causing so much anxiety in many parts of the world, will be stopped, as the people will find in the interior of their own country the work and means of livelihood which they now seek for elsewhere.

— The Illinois experiment station is located at Champaign, on a black prairie soil, upon which fertilizers, except barn-yard manure, have failed to produce any increase in wheat. The following experiments, made on soils of a different character, are reported by Professor Morrow in a recent bulletin of the station: For three years past experiments with commercial fertilizers on wheat have been tried at points farther south than the station grounds. For 1890–91 the trials were made on the farms of W. W. Bowler, Flora; A. M. Woodward & Co., Odin; Chas. Stephani, Nashville; and Fred. Helms, Wilderman, near Belleville. These are all not far from latitude 38° 30′, and, except the last-named, on the level light-colored soils characteristic of that region. Mr. Helms's soil is darker colored and naturally very fertile. Mr. Bowler's land had been in grass from 1883 to 1888. In 1889 it produced about forty bushels of corn per acre. In 1890 it was sown to oats, but the crop failed. The land at Odin had been thrown out of cultivation until 1889, when it produced a fair crop of corn. In 1890 it was sown to oats, which failed to produce a crop. The land at Nashville had been in cultivation about forty years — in corn in 1883 and 1884, oats in 1885, wheat in 1886, oats in 1887, wheat in 1888 and 1889, and in oats in 1890. Mr. Helms's land had been cultivated by him twenty-two years without manure. It was in wheat on clover sod in 1889–90, and yielded about thirty bushels per acre. In each case, except at Flora, nine plats two by twenty rods, containing one-fourth of an acre each, were used. To plat 1 in each case five wagon-loads of barnyard manure were applied, and 100 pounds of glue-factory superphosphate to plats 3, 4, 6, 7, and 9. The barnyard manure and superphosphate were applied before sowing. In each case the land had the treatment usual in the region in preparing for wheat. The wheat was sown with a drill about Sept. 20, 1890. The winter was favorable for the crop. When visited at the last of April, as well as at harvest time, the effect of the barnyard manure in stimulating growth was very apparent; that of the superphosphate, less so. The wheat was carefully harvested and threshed from the shock, except at Flora, where Mr. Bowler was compelled to put it in stack and thresh Aug. 20. Mr. Helms estimates that his crop was damaged one-fifth or more by plant lice. The wheat at Nashville was measured; at the other places, weighed. It was all of good quality. The average results are given as follows: At Flora, 20 loads manure, 25.47 bushels wheat per acre; 400 pounds superphosphate, 17.83 bushels wheat; unfertilized, 19.71 bushels wheat. Odin, 20 loads manure, 25.47 bushels wheat; 400 pounds superphosphate, 19.85 bushels wheat; unfertilized, 19.64 bushels. Nashville, 20 loads manure, 28.00 bushels; 400 pounds superphosphate, 16.00 bushels; unfertilized, 10.00 bushels. Belleville, 20 loads manure, 40.70 bushels; 400 pounds superphosphate, 39.85 bushels; unfertilized, 36.65 bushels.

— While the International Marine Congress was in session in Washington in 1889, the question was raised as to the proper power of the running lights used by vessels of the merchant marine. No agreement could be reached, as the Congress was without accurate knowledge as to the intensity of the lights proposed. It has been decided that the side-lights of a vessel under way, which should be red on one side and green on the other, ought to be sufficiently powerful to be seen two miles, while the white top lights should be seen five miles. The Light-House Board was formally requested to ascertain the needed intensity of the proposed lights by actual experiment. The board therefore appointed a committee of five, consisting of two light-house inspectors, who are respectively a captain and a commander in the United States navy, two light-house engineers, who are respectively a major and a captain of the Corps of Engineers in the United States army, with a member of the Light-House Board as its chairman. The committee did its work by making actual tests at night, running a steamer at Gardiner's Bay, Long Island Sound, over a measured course, and sighting from various known distances, white, red, and green lights, the actual intensity of which had been determined by photometric measurement. This committee of specialists was attended by a staff of experts to put and keep the apparatus in thorough order. Two nights, each of a different character as to clearness, were spent in making these experiments, and two tabular statements showing actual and accurate results have been prepared. The result is that all the tests have been averaged, the personal equation of the observers has been eliminated, and a full report of the results attained has been made. From this it appears, stated in brief, that to be practically seen in fairly clear weather for five miles, a white light must have an intensity of thirty candle power, and that red and green lights to be seen two miles must each have a power of forty candles.

— A recent report by the United States consul at Martinique gives some details concerning the hurricane at that island on August 18. He states that early on that morning the sky presented a very leaden appearance, decidedly threatening, with occasional gusts of variable winds, mostly from the east-north east. The temperature was very oppressive during the entire day. The barometer varied only slightly, but was a little higher than usual until afternoon, when it commenced to fall, at first gradually and then very rapidly. The storm struck the east side of the island at about 6 P.M., rushing through the ravines with terrible force, and destroying every thing in its path. On the elevated plains the ruin was most complete. One very peculiar feature of the hurricane was the deafness experienced by every one during the storm, possibly the result of the reduced barometric pressure. During the cyclone the wind veered from east-north-east to south-south east, the latter being most destructive. During the storm there were incessant flashes of sheet lightning, unaccompanied by thunder, and immediately after the storm there were two distinct shocks of earthquake, at intervals of about five seconds. Early in September the consul visited Trinité, and all the way the destruction was most complete, the trees and vegetation looking as though there had been a forest fire, although without the charred appearance. The thermometer ranged from 90° to 100° F. during the storm. There was a deluge of rain, one account stating that over four inches fell in a few hours that evening. Nine-tenths of the buildings throughout the island were unroofed. The loss of life was small in St. Pierre, but large in the interior towns. The total loss of life, so far as reliable information can be obtained, was seven hundred, and the loss of property was enormous. All the fruit, the main reliance of the laboring class, was destroyed, and prices of provisions have advanced three hundred per cent. Every vessel was wrecked or badly damaged, fifty sail in all. A clipping from a Martinique newspaper states that the barometer fell 27.95 inches at Fort de France. At St. Pierre the wind blew a hurricane from the north-east, from 7 to 8.15 P.M., when the rain suddenly stopped and it fell calm, the sky becoming clear. This marked the passage of the centre. At 8.30 the hurricane recommenced from the south-west, and blew with great fury until 9.30, the barometer rising and the wind shifting to the south-east. At 10.30 there were still strong squalls from the south-east, but the storm was practically over.

—Professor Frank H. Bigelow, at one time professor of mathematics and astronomy at Racine College, has been appointed a professor in the United States Weather Bureau.

— The Salisbury expedition to the Galapagos Islands, headed by Dr. Baur of Clark University, has returned to Worcester, Mass. It brings a large collection of scientific specimens.

— Dr. Alfred S. Bolles, superintendent of the Pennsylvania Bureau of Statistics at Harrisburg, and editor of the *Bankers' Magazine*, has been elected lecturer in mercantile law and banking in the University of Pennsylvania. Dr. John I. Reese has resigned the chair of medical jurisprudence and toxicology in the same university. In the Wharton School of Finance, Mr. L. K. Stein of Johns Hopkins University has been elected assistant, Dr. Sydney Sherwood, a Princeton graduate, becomes instructor in finance, and Dr. Frederick W. Moore of Yale, instructor in sociology.

— An instrument for optical comparison of transparent liquids, named a "liquoscope," has been recently devised by M. Sonden of Stockholm (*Nature*, Sept. 17). Two hollow prisms holding the liquids are separated by a partition at right angles to the refracting angle. The whole is placed in a vessel filled with glycerine, and which allows of vision in a horizontal direction through plane glass plates. The deflection of the light rays through the prisms is thus compensated. So long as the two liquids have the same optical action, one sees a distinct mark (say a black paper strip on a window) as a straight connected line; but its halves are relatively displaced if the liquids have different refractive powers. The amount of displacement gives a measure of the difference, the positive or negative nature of which also appears from the direction of displacement. The author recommends his apparatus for chemical purposes, especially comparison and testing of fats and oils, analysis of glycerine, etc., and detection of margarine in butter, margarine greatly lowering the index of refraction.

— In a paper published in the current number of the Journal of the Anthropological Society, Mr. J. J. Lister refers to the great development of the arms and chests of the natives of Fakaofu (Bowditch Island, Union Group). According to *Nature*, he thinks it may be due to the fact that they are obliged to go about so much in canoes. Sir Joseph Lister, who took part in the discussion which followed the reading of this paper, remarked that he would not have expected the frequently repeated action of paddling to produce lengthening of the arms, although he could understand its resulting in increased size of chest. He pointed out that the natives of Tonga were also accustomed to use canoes, and hence it was not clear that the phenomenon could be traced to the cause assigned. Mr. Lister replied that, although the Tongans use canoes, canoe work is not so essential a part of their lives as it is in the case of the natives of Fakaofu. The natives of the island of Tongatabu have many avocations quite apart from the sea, for they live on an island twenty two miles long, and many villages are situated some distance from the water. The natives of Fakaofu, on the other hand, live crowded together on a small islet situated on a ring of reefs, and to meet almost every need of their lives they must do more or less paddling.

— Herr Fleitmann's experiments in soldering iron with nickel have yielded some important results with regard to the volatility and atomic penetration of the former metal, says *Iron*. The adhesion of the two metals was so intense that it became impossible to separate them by mechanical action, and chemical analysis proved a perfect assimilation, although the soldering had been effected at a temperature of from 500° to 600° below the fusing point. Other tests established the volatility of iron when heated to cherry redness. Two plates of iron and nickel, superposed, were submitted to the same degree of heat; the iron passed into the nickel to a notable extent without soldering or adhesion of the surfaces resulting. On the whole surface of the sheet of nickel an alloy with the iron was formed, which, in the case of one-millimetre sheets, penetrated to five one-hundredths of their thickness, and contained on the average twenty-four per cent of that metal, the proportion being naturally stronger on the surface. An important fact is that the passage of the iron to the nickel is not reciprocal. While the combination disclosed itself on the surface of the nickel plate by the argentiferous lustre of an alloy of iron with fifty per cent of nickel, the iron plate remained intact, and preserved the sombre appearance which it had received from the scaling.

— In 1857 Wilhelm Struve, founder of the Pulkova Observatory, entered into negotiations with Prussia, Belgium, and England, with a view to the measurement of an arc of parallel of latitude stretching across the four countries. The Governments named consented, in 1863, to communicate the results of their measurements to Otto, son and successor of Wilhelm Struve, in order that he might co-ordinate them with the Russian triangulation. The measurement of the arc is not yet completed, but some particulars concerning the work have been published in a recent issue of the *Scottish Geographical Magazine*. The parallel chosen is that of 52° north latitude, and the angular extension of the arc is 59° 30′. The portion which lies within the bounds of Russia in Europe measures rather more than 1,682 miles in length, and gives the average length of a degree of longitude as about 42.68 miles. The geodetic measurements proved beyond a doubt that the length of a degree is not always the same, that, in fact, the parallel of 52° is not a circle, but is composed of elliptical arcs. Bases of 4 to 9 versts have been measured with such care as to reduce the limit of error to the hundredth part of a millimetre, yet the lengths of a degree of longitude in different parts of the parallel show differences ranging up to 410 feet. It is expected that the measurement will be continued across Siberia to the Pacific.

— *Nature* states that Herr Hufner has lately pointed out some of the biological bearings of the fact (observed in experiment along with Herr Albrecht) that long light-waves are much more strongly absorbed by water than short ones. If the lower marine animals had, like man, the liveliest light-perception with yellow rays, and a certain intensity of light were necessary to them, they must live at a less depth than if their visual organs were most strongly affected by short-waved rays. Thus, e.g., if they needed as much yellow light as that of the full moon, they could not live deeper than 177 metres (say, 590 feet). Yet they are found at all depths where food, oxygen, and a suitable temperature exist. On the other hand, the existence of plants having chlorophyll depends on light, and we might expect that the distribution of non-parasitic plants would be very limited, which is the case, no plant-organisms being found under 200 fathoms. Green plants assimilate best in yellow light; and supposing plants to assimilate in moonlight they would find their limit at the above depth (177 metres). But while yellow is here weakened to 0.0000016 of its brightness, indigo blue has still 0.007829 of its original strength, and the assimilation with blue rays will be 660 times as strong as with yellow. Different colored marine plants react differently according to the color of light, and they have accordingly different distribution in depth.

— The American Press Company of Baltimore announces a work entitled "The Builders of a Great Country." It will be a book of representative Americans. The proposed work will contain biographies and portraits of those who are recognized as the representative Americans of the age in church and state, politics and commerce, science and manufactures, literature and art, press and progress.

— An important work on the science and practice of medicine is announced by the Librairie G. Masson, Paris, under the editorship of Doctors Charcot, Bouchard, and Brissaud. "Le Traité de Médecine" will form six volumes, to be published within a maximum period of two years. The first volume, just ready, includes general infectious pathology, diseases of nutrition, diseases common to man and animals, and infectious diseases. The second volume will treat of fevers, cutaneous affections, diseases of the blood, and intoxication.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

MOLECULAR MOTION IN HYDRODYNAMICS.

PROFESSOR JOSIAH P. COOKE'S "New Chemistry" has done much to dissipate the mystery which hung around the subject of molecules in my mind before this light was turned on. The physicist, says Professor Cooke, "may prefer to define molecules as those small particles of bodies which are not subdivided when the state of aggregation is changed by heat, and which move as units under the influence of this agent. To the chemist, on the other hand, the molecules determine those differences which distinguish substances. . . . Hence the chemist's definition of a molecure: 'The smallest particles of a substance in which the qualities inhere, or the smallest particles of a substance which can exist by themselves,' for both definitions are essentially the same" ("New Chemistry," pp. 99, 100). When we try to contemplate the magnitude of these small particles, the mind becomes bewildered by the immensity of the minuteness, in the same way that it is bewildered by the immensity of the expansion when it tries to penetrate the uttermost depths of the celestial spaces. But every child who sees the stars at night peers into these depths, and every one who hears the whistle or the rumble of a steam-engine is listening to the sound of work done by the movement of these minute particles

In the long series of experiments which enabled Mr. William Crookes to develop the radiometer and Crookes's tubes, he became very familiar with these small bodies: not quite enough so to handle them as a boy does his marbles, or a sportsman his shot; but he furnished abundant proof, if any further proof was required, that the molecules are separate bodies of matter, each with the capacity for its own proper motion and of doing its own proper work. It is true that he did not prove that one molecule by itself could be made to do work like a rifle ball, because he failed to separate one from all others; but he leaves no doubt that when moving together, like shot from a smooth-bore gun, each molecule has its own proper motion and does its own proper work.

Applying this determination to the phenomena of hydromechanics, the explanation it affords is astonishing for its simplicity. This application is entirely legitimate; for while Mr. Crookes's operations were on matter in gaseous form, it is now well known that all matter can be changed from one form to another, and the change of the substance which is the subject of hydromechanics from the solid form of ice to the liquid form of water and the gaseous form of vapor, are amongst the most obvious of all phenomena. Moreover, the very fact that water flows, demonstrates its separation into particles each capable of independent motion of its own. When grain passes along a conduit in an elevator, or when seed or shot are poured from one bag or vessel into another, there is a flow, each particle having a certain motion of its own; one moves faster and another slower, as it happens to be more or less subjected to the impelling force. If the particles did not change position in respect to each other, the phenomena would be sliding, not flowing. The essential difference between sliding and flowing is that in the one case, the particles, large or small, constituting the moving body, do not necessarily change position in respect to each other, while in the other this change of relative position of the particles really constitutes the movement of the mass. This is beautifully illustrated by pouring corn into a hopper or bin. When the bag or vessel containing the corn is tilted the grains on top begin to move toward the lower side, and presently begin to pour over, and are followed by the others, each one moving in obedience to its own gravitation and the pressure, if any, from grains above it, and its movement is determined by the resistance it encounters from other grains and the sides of the containing vessel. When the operation is completed no two grains probably occupy the same position in respect to each other, in the hopper or bin, that they did in the vessel from which they were poured. It is said that no two grains are precisely alike in every particular, and it is certainly probable that when a mass of grain flows from one vessel into another, no two of them have identically the same motion both in direction and velocity. The gravitational pull on each is the same, but the variation in pressure and resistance to which they are respectively subjected is practically infinite.

This phenomenon of flow is impossible except in a mass composed of particles free to move in respect to each other, and, therefore, the flowing of water is itself sufficient evidence that the water is composed of particles free to move in respect to each other, and that this motion of particles actually occurs whenever water or any other liquid flows. The decomposition of water has demonstrated that the particles composing it are molecules, as defined by Professor Cooke; that is to say, the particles constituting the water itself are the smallest in which the qualities of the substance inhere, and not aggregations of these smallest particles. When a molecule of water is subdivided, as it may be, there is no water left; the water is destroyed, and the matter assumes the form of oxygen and hydrogen, which in certain combination form the molecule of water. (Decomposition, *ex vi termini*, imports a separation of particles; thus when ice is decomposed into water, the particles separate, and there is a further separation of particles when water is decomposed into vapor; therefore when further decomposition destroys the substance itself, it is obvious that the substance must have been subdivided by precedent decomposition into the smallest particles in which its qualities inhere.) It is obvious, therefore, that a vessel full of water is filled with an aggregation of molecules, in the same sense precisely that a bushel measure full of corn is filled with an aggregation of grains.

It is not necessary for us to determine whether the molecules of water are held apart and kept separate by intermolecular vibration, as supposed in the kinetic theory: nor whether the atoms constituting the molecules "are in a state of vibration or rotation motion, in short, comparable to the bodies of the solar system," as suggested by Mr. William Crookes in a recent article in *The Forum*. These interesting qualities, supposed to be possessed by molecules, or by atoms constituting the molecules, but not by particles composed of an aggregation of molecules, are in no wise inconsistent with the obvious fact that molecules possess some of the qualities of other particles of matter: they are subject to the force of gravitation; that is, they have weight, and weight is simply the evidence and measure of the earth's gravitational attraction. Considering, then, that a body of water consists of molecules in the same sense that a body of corn consists of grains, it is manifest that the molecules below the surface must sustain the pressure caused by the weight of the superincumbent molecules above, and that this pressure must increase with the depth, because the quantity of superincumbent molecules increases in the same ratio. An increase of pressure not essentially different occurs whenever particles of any kind are superimposed, as in a grain elevator or a brick wall. It is therefore obvious that nothing but the weight of the superincumbent molecules is necessary to account for hydrostatic pressure; and the molecules being free to move in respect to each other, all the phenomena of hydrostatic pressure must follow, under the general law of the conservation of energy, and its resultant, that motion is always in the direction of least resistance.

But it is not necessary to consider in detail the phenomena of hydrostatic pressure, for they are the secondary and not the immediate results of molecular motion, that is, of the motion of the molecules constituting the water. This motion is the change of position of molecules which constitute the mass or body of water, in respect to each other, and is contra-distinguished from molar motion, which is the change of position of the mass in respect to other masses, or of part of a mass in respect to other parts of the same mass. Molecular motion may occur from convection without molar motion, as when heat below the boiling point is applied to the bottom of a vessel containing water; the heated molecules rise to the surface, and the colder molecules at the surface sink towards the bottom, the body or mass of the water remaining stationary. So there may be molar motion without molecular motion, as when a vessel full of water is moved from one place to another without agitating the water. But in the phenomena of flowing or pouring, both of these motions necessarily occur: there is a change of the position of the molecules if the subject be water, or of the particles if the subject be grain, seed, shot, etc., in respect to each other, and there is also a change of position of the mass in respect to other things, and of parts of the mass in respect to other parts of the same mass. When corn is poured from one vessel into another, we can see the grains change position in respect to each other, and if this did not occur we would know at once that the grain was sliding, not pouring or flowing. We cannot see, even with the most powerful glasses, the molecules of water: one grain of corn equals in bulk many billions of them; but the results of the phenomena of flowing and pouring water leave no more doubt that the molecules do change position in respect to each other, than if we saw the motion of each one separately. Indeed, if the lower part of the water in a vessel be colored with sediment or other matter, and the water be poured into another vessel, we have visible evidence of the change of position of the molecules in respect to each other by the transfusion of the colored particles throughout the mass in the second vessel.

Flowing and pouring are terms used to express different phases of the same phenomenon. What actually occurs in every case of flowing or pouring is the transference of a fluid or semi-fluid—that is, of a mass composed of small particles—from one place or vessel to another by the action of gravitation or some other force acting directly on the mass itself, and not merely on the vessel containing the mass. We know by observation when this phenomenon occurs in a quasi-fluid, consisting of grains or particles large enough to

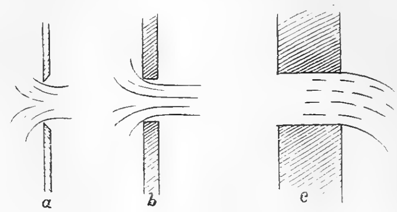

FIG. 20.

be observed, that each grain or particle has a motion of its own, and is subject to the mechanical laws applicable to all moving bodies; and assuming the same to be true in respect to the invisible molecules constituting a fluid proper, we find an explanation of the phenomena of hydraulics, absolutely simple and perfectly satisfactory.

For example we will take the diminution in the diameter of a jet projected from an orifice in a plain surface; and to illustrate the phenomenon we will borrow the following explanation and diagrams from the last edition of the "Encyclopedia Britannica": "When a jet issues from an aperture

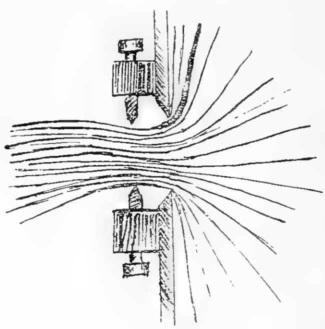

FIG. 21.

in a vessel, it may either spring clear from the inner edge of the orifice as at *a* or *b* [Fig. 20], or it may adhere to the sides of the orifice as at *c*. The former condition will be found if the orifice is beveled outwards as at *a*, so as to be sharp-edged, and it will occur generally for a prismatic aperture like *b*, provided the thickness of the vessel round the aperture is less than the diameter of the jet. But if the thickness is greater the condition shown at *c* will occur. When the discharge takes place as at *a* or *b*, the section of the jet is smaller than the section of the orifice. This is due to the formation of the jet from filaments converging to the orifice in all directions inside the vessel. The inertia of the filaments opposes sudden change of direction of motion at the edge of the orifice, and the convergence continues for a distance of about half the diameter of the orifice beyond it. . . . When the orifice is a sharp-edged orifice in a plain surface, . . . the section of the jet is very nearly five-eighths of the orifice. . . . Hence the actual discharge when contraction occurs is . . . 0.62." "The co efficient of contraction is directly determined by measuring the dimensions of the jet. For this purpose fixed screws of fine pitch [Fig. 21] are convenient. These are set to touch the jet, and the distance between them can be measured at leisure." Without stopping to inquire what reason there may be, either in theory or from observation, for the assumption that the molecules, or particles of water, form themselves into *filaments*, and that the jet is formed from these filaments, it is obvious that the assumption is not necessary to account for the phenomenon, and that the diminution of the jet is the necessary result of well-known mechanical laws operating on each molecule separately.

Each molecule put in motion by the outflow of the jet moves from its position in the vessel towards the orifice: the motion is constantly accelerated until it reaches the orifice, and its velocity is determined by the pressure to which the molecule is subjected and the resistance it encounters. The molecules on the same horizontal plane as the orifice, and

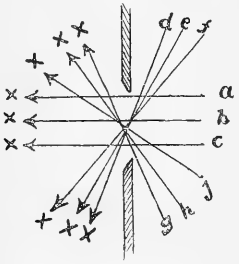

FIG. 21 (modified).

on lines which lead through it, move on these lines directly outwards through the orifice; but the molecules above and below and on each side of the orifice move towards it at an angle to the direction of the outflow, and a part of the kinetic energy of the molecules moving directing in the line of outflow is necessarily consumed in changing the direction of the molecules from above, below, and from the sides, which are moving at an angle to this direction. In other words, it is the ordinary simple problem of moving bodies coming into contact at an angle to their lines of motion, and the direction of motion and kinetic energy are the resultant of the forces operating at the impact.

This can be illustrated by reproducing Fig. 21, omitting the set-screws, and substituting for the filaments a few molecules with lines showing the direction of their motion. The molecules a, b, and c move on the lines ax, bx, and cx, while the molecules d, e, f, move on the lines dx, ex, and fx, and the molecules g, h, i, move on the lines gx, hx, and ix, and so with all the others. The amount of kinetic energy consumed in changing the direction of the molecules moving to the orifice at an angle to the direction of the outflow, determines the diminution of area of the jet as compared with the area of the orifice, and determines also the co-efficient of discharge.

When the point of maximum contraction is reached, the molecules, under another well-known law of mechanics, rebound from each other, and at about the distance from the orifice to the point of maximum contraction, the area of the jet is enlarged so that it equals the area of the orifice, and farther on becomes much larger. The amount of contraction of the jet is necessarily variable, depending as it does on the direction of the molecules when they reach the orifice. If the vessel is narrow, or if, in Fig. 21, an obstruction be placed in the vessel in front of the orifice, so as to diminish the relative number of molecules which can move on the lines ax, bx, and cx, as compared with those which move at an angle to the line of outflow, the area of the jet and co-efficient of discharge will be measurably diminished.

If the orifice is bell-mouthed, or otherwise so constructed that the kinetic energy required to change the direction of all the molecules is exerted before any of them reach the orifice, then there is no contraction of the jet, and the co-efficient of discharge rises from about 0.62 to about 0.96 under the same conditions in other respects.

But it is in determining the depth at which the maximum velocity is found in a flowing stream that the molecular motion becomes of the greatest importance. We again have recourse to the "Encyclopedia Britannica" for a description of the phenomenon, and the existing theories in respect to it: "In the next place, all the best observations show that the maximum velocity is to be found, not at the free surface of the stream, but some distance below it. In the experiments on the Mississippi the vertical velocity curve in calm weather was found to agree fairly well with a parabola, the greatest velocity being at three-tenths of the depth of the stream from the surface. With a wind blowing down-stream the surface velocity is increased and the axis of the parabola approaches the surface. On the contrary, with the wind blowing up-stream the surface velocity is diminished, and the axis of the parabola is lowered, sometimes to half the depth of the stream. The American observers drew from their observations the conclusion that there was an energetic retarding action at the surface of a stream like that due to the bottom and sides. If there were such a retarding action, the position of the filament of maximum velocity below the surface would be explained. It is not difficult to understand that a wind acting on surface ripples should accelerate or retard the surface motion of the stream, and the Mississippi results may be accepted, so far as showing that the surface velocity of a stream is variable when the mean velocity is constant. Hence, observations on surface velocity by floats and otherwise should only be made in very calm weather. But it is very difficult to suppose that in still air there is a resistance at the free surface of the stream at all analogous to that at the sides and bottom. Further, in very careful experiments, Boileau found the maximum velocity, though raised a little above its velocity for calm weather, still at considerable distance below the surface velocity, even when the wind was blowing down-stream with a velocity greater than that of the stream, and when the action of the air must have been an accelerating and not a retarding action. Professor James Thomson has given a much more probable explanation of the diminution of the velocity at and near the free surface. He points out that portions of water, with a diminished velocity by retardation from the sides or bottom, are thrown off in eddying masses and mingle with the rest of the stream. These eddying masses modify the velocity in all parts of the stream, but have their greatest influence at the free surface. Reaching the free surface, they spread out and remain there, mingling with the water at that level.

and diminishing the velocity which would otherwise be found there."

Then follow the determinations of Boileau and of Bazin, from which it may be inferred "that the ratio at which the maximum velocity is found to the whole depth ranges from zero to 0.2, except in some artificial channels, where it reached 0.35. The Mississippi experiments give different results, and Bazin inclines to believe that the method of experimenting was untrustworthy. The ratio is greatest in artificial channels with smooth bottoms, and least in natural streams with rough bottoms.

It is difficult to understand what force could cause the portions of water retarded by the sides or bottom to spread themselves with constant uniformity over the unimpeded current flowing below the surface in mid-stream, and especially how the portions retarded by the bottom could rise up through or pass around the more rapid portions above them. But the phenomenon becomes very simple if we suppose that each molecule of the water has its own proper motion, governed by well-known mechanical laws. The impetus to the motion is determined by the pressure, and the actual motion is necessarily the resultant of the difference between the pressure and the resistance. If there were no resistance to the flow of the stream, there would be constant acceleration of motion from top to bottom, just as there is in jets from the side of a vessel, the flow from each being determined by the pressure above it. But in a flowing stream there is great resistance from the sides and bottom, the resistance from the bottom necessarily increasing with the pressure, and this resistance which the molecules receive from the bottom is transmitted, just as pressure is from above, to the molecules adjacent to them. At the depth where the impetus to motion by the pressure from above comes into equipoise with the resistance to motion from below, there ought to be, as there is in fact, the greatest velocity of flow. The resistance from the bottom remains practically constant at any given place in the stream. Wind blowing up-stream increases the pressure by holding back the surface molecules; hence this increase of pressure, the resistance remaining constant, causes the level of maximum velocity to descend. On the other hand, when the wind blows down-stream there is a diminution of pressure, because the surface molecules are pushed forwards in the direction of their movement; hence this diminution of pressure, the resistance still remaining constant, causes the level of maximum velocity to ascend. When the flow is through a round pipe entirely filled with water, and under such pressure that the influence of gravity on the stream itself may be disregarded, it is obvious that the maximum velocity is through the centre of the pipe; the pressure is uniform in all parts of a cross-section of the pipe, and the resistance from friction against the pipe is likewise uniform in all directions from the centre.

It is not necessary to seek further evidence of molecular motion in other phenomena of hydraulics. The evidence is manifest in all the phenomena that I have examined; and the motion is not only consistent with the facts, but the hypothesis of its existence clears up many things which without it are obscure. The explanation which it furnishes of the phenomena of wave motion is especially interesting, but the subject is too large for consideration in this paper.

It seems to me, therefore, that, without further illustration, we may assume as determined that, in all flowing, the particles or molecules constituting the body in which the phenomenon occurs, whether visible or invisible, have each its own proper motion, determined by the forces and resistances to which it is subjected, and that the molar motion is made up of the aggregation of these molecular or particle-motions, — and in this consists the specific difference between flowing and sliding.

This determination is evidently of theoretical importance in hydromechanics and in pneumatics, for the law must apply to the flowing of gas as well as to the flow of liquids, and it may lead to other determinations of great practical value in one or both of these sciences. But since Mr. Crookes has put the molecules of residual gas, in the bulb of the radiometer and in his tubes, to doing mechanical work, the basis has been laid for the development of the science of molecular mechanics, and it is in this new field that this determination has its greatest importance.

The eyes of scientists are being directed to what we might call the small end of nature, and we are discovering that microbes, bacilli, bacteria, etc., are of more importance to mankind than the cedars of Lebanon, or the beasts which roamed beneath them, or the birds which sought shelter in their branches. So in this new science of molecular mechanics, the way to which has been opened up to us by Mr. Crookes's researches, we have the promise of additions to scientific knowledge more important even than the magnificent results which followed the application of mechanical laws to the movements of the celestial bodies.

DANIEL S. TROY.

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.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Rain-Making.

IN the issue of *Science* of Aug. 28 there appears a communication from Professor H. A. Hazen attacking the artificial rain theory, to some points in which I ask the privilege of making reply.

Professor Hazen commences by saying that "ever since the time of Plutarch the idea has been prevalent that great battles are invariably followed by rain." Now, I would ask where Professor Hazen gets his authority for this broad and sweeping statement? In what writings, following those of Plutarch, does he find any reference to the matter up to the time of Benvenuto Cellini, who is said to have written that a discharge of artillery affected meteorological conditions? Plutarch lived in the first century of the Christian era, Cellini lived in the sixteenth century. Here is a great gap of about fifteen hundred years, and if there is any evidence that the idea prevailed, during that time, that battles caused rain, I challenge my critic to produce it.

A great many writers besides Professor Hazen have brought forward the statement of Plutarch relative to rains following battles as an argument against the concussion theory of rain-production, and some appear to think the argument quite unanswerable. It is, however, very easily disposed of, for the notion referred to by Plutarch was an entirely different matter from that which, so far as we know, did not come into notice until fifteen hundred years later. It was wholly different, in that it did not relate to rains immediately following battles. The only place in which Plutarch mentions the subject is in his life of Marius, in speaking of the defeat of the Ambrones by the Romans. The rains which he says followed that battle did not occur until the winter following. And in mentioning the subject in a general way in connection with this one specific instance, the whole tenor of what he says conveys the idea that the rains he referred to did not occur until a considerable time after the battles, nor until the bodies of the slain had putrified. To give what he says other meaning is to make his attempted explanation of the cause of the rains wholly inapplicable. How absurd, then, to claim that the ancients had the same notion in regard to rains following battles as that which prevails at the present day. We might well question, indeed, whether there was any such idea prevailing among the ancients as that to which Plutarch alludes, as a single and unsupported statement by one writer alone is not very conclusive evidence; but admitting that he may have spoken advisedly on the subject, it is plain that it was not a "common thought" with that of the moderns, and all reasoning against the concussion theory based on it must fall to the ground.

The second point in Professor Hazen's article to which I wish to refer is the wholly unwarranted assumption that all, or nearly all, the battles of our late war which I have not shown in "War and the Weather" to have been followed by rain were not so followed. On a par with this is the violence he does to history in assuming that the 2,200 battles which he says were fought during that war were, on an average, as severe as the 158 mentioned in my book. The greater part of the 2,042 which he says I do not mention could have been nothing more than skirmishes. The most remarkable thing about Professor Hazen's article is that although he has read my book he pays no attention to any of the explanations or arguments I make. I explain the difficulty, from want of records, of getting reliable information in regard to the weather following the land battles that were fought, and he coolly proceeds to count all those not proved to have been followed by rain as belonging to the other side. I give a reason why we should not expect skirmishes to produce rain, and he counts them all in as if one such, not followed by rain, furnished as good evidence against the theory as a great battle followed by heavy rain furnishes for it. By this cheap method of figuring he makes out that only seven per cent of the battles were followed by rain. What weight has such an argument against the fact that all the great historic battles of the war, so far as reliable information can be obtained, were followed by heavy rains?

Professor Hazen argues that the influence of explosions could not extend twenty-four hours, for the reason that the current subjected to it "is borne along at the rate of 20, and, in the higher strata, at 30, 40, 50, and more, miles per hour, so that the specific influence from them will be carried at least 500 miles away in twenty-four hours." Now the learned professor cannot be sure of his ground here unless his knowledge of all atmospheric movements and of processes in the formation of storm centres is infallible. It is generally understood that our Weather Bureau claims such infallibility, though Professor Hazen in another part of his article seems to disclaim it, and though some of the unscientific laity are inclined to believe that the whole orthodox theory of rainformation will yet have to be remodelled.

Professor Hazen does not think my explanation of the point under consideration worthy of notice, as he does not refer to it. This explanation is as follows. The storm centre may remain stationary over the place where the firing takes place until the storm is fully established, because it is caused by the mingling of two currents of air flowing in nearly opposite directions. At the commencement, the new action set up is confined to the upper stratum of the lower current and the lower stratum of the upper current. These, mingling together, set up a rotary motion, but as a whole, the air partaking of this motion moves neither very far east nor very far west, being acted on by opposing forces, one tending to carry it eastward and the other westward. When, however, large enough volumes of air become involved in the motion to produce rain, the storm will move eastward along with the warm current. As this is not orthodox philosophy as held by the scientists of the Weather Bureau, Professor Hazen will have none of it. But perhaps he will remember cases in which storm centres have lingered long in one place, and, if so, this fact alone furnishes a sufficient argument in refutation of his own

There is only one other point in Professor Hazen's article that I wish to notice, and that is this: he says, "One thing seems very evident, that absolutely no rain can be obtained out of a dry atmosphere." This is an old argument the extreme tenuity of which I have often shown. Professor Hazen well knows how I have met it by showing that there are probably at all times sufficient quantities of aqueous vapor flowing above us in air currents to make rain. He cannot refute my argument on this point, nor I believe, show that there is anything unreasonable in it, therefore he very wisely ignores it. My argument is based on the absolutely certain fact that as much water must come to us from the ocean as runs into the ocean from our rivers, and on the further fact, demonstrated by Professor M. F. Maury, that most of the vapor that forms our rains comes to us from the Pacific Ocean. Coming from the Pacific, it necessarily comes in air currents which flow above the mountains and high above the arid regions of the West. Meteorologists will come nearer a solution of the problem of rainproduction when they recognize the fact that it is not the moisture in the lower air east of those mountains and arid districts that gives us our rains, but that it is the rains formed mainly by the condensation of the vapor from the Pacific that cause the moisture. EDWARD POWERS.

Delavan, Wis, Sept. 26.

BOOK-REVIEWS.

Schliemann's Excavations. By DR. C. SCHUCHHARDT. Trans. from the German by Eugénie Sellers. New York, Macmillan. $4.

THE object of this work is to give a succinct account of Dr. Schliemann's discoveries, sufficient for most students of the subject, and presenting the net results in a single volume. The reports heretofore made of the excavations, chiefly by Dr. Schliemann himself, are contained in several different books published at intervals, none of which contains a complete account of the whole work, so that a good summary was much needed; and such a summary Dr. Schuchhardt, with the approval of Schliemann himself, has here given us. He has also taken account of the discoveries that have been made by others, especially those of the Greek Archæological Society, while Drs. Schliemann and Dörpfeld have given in an appendix reports of their excavations at Hissarlik last year; so that we get a complete account of all that has been done. Mr. Walter Leaf contributes an introduction in which he discusses certain points of interest, expressing in some cases somewhat different views from those of Dr. Schuchhardt. Dr. Schliemann's work was so emphatically the result of his own personality, and his life was in itself so interesting, that Dr. Schuchhardt very properly begins his volume with a biographical sketch. Schliemann was the son of a clergyman, and received excellent schooling in early boyhood; but, owing to misfortunes in the family, he was obliged to leave school and go to work to earn his living. For several years his life was hard; but at last a firm in Amsterdam detected his commercial abilities, and from that time his advancement was rapid. The foundation of his large fortune seems to have been laid in Russia during the Crimean war; but it was not until several years later that he was able to retire from business with a fortune sufficient to carry on the archæological researches which had been the dream of his life. The first sod was turned at Hissarlik in 1870, and, as the excavations were continued with some interruptions until the great explorer's death last year, they covered a period of twenty years.

Of the importance of the work thus done there can be no doubt; it was, as Mr. Leaf remarks, nothing less than the creation of prehistoric Greek archæology. Before Schliemann's excavations began, most scholars doubted the story of the Trojan war, maintaining that it was a poetic fiction and that the personages represented in the "Iliad" and "Odyssey" were mythical, and there was great uncertainty as to the site of Troy itself. Dr. Schliemann has now uncovered the site of Troy just where Greek tradition uniformly placed it; and, as the ruins show that the city was destroyed by fire, its reduction by siege is highly probable. Thus far only the citadel has been excavated; but the massiveness of its walls prove that it must have been the nucleus of a large and powerful city, though the utensils and ornaments that have been found indicate a lower stage of civilization than that of the prehistoric cities on the European side of the sea.

It is at these last-named cities, indeed, and especially at Mycenæ and Tiryns, that the most important discoveries have been made. Tiryns, which stood nearest the sea, was first excavated, and here Schliemann first had the assistance of Dr. W. Dörpfeld, who had previously been engaged on the German excavations at Olympia. The remains uncovered at Tiryns consist of a citadel and palaces almost identical in plan with those of Troy; and these features are repeated with some variations at Mycenæ. It was at this latter place, however, which Homer has celebrated as the capital of Agamemnon's empire, that the greatest variety of remains were found, and Dr. Schuchhardt has devoted nearly half of this book to a description of them. There are at Mycenæ two different kinds of burial places, the bee-hive tombs outside the citadel (so called from the form of the principal vaulted chamber), and the shaft graves within the citadel, which are simple pits sunk in the ground and covered by a slab. The bee-hive tombs, which belong to the later ages of the Mycenæan civilization, have long since been rifled of their contents; but the shaft graves were found to contain remnants of corpses, together with a great variety of utensils, ornaments, and weapons which reveal a high order of workmanship and artistic skill. The shield of Achilles and other works of art spoken of in the "Iliad" have been regarded as extravagant creations of the poet's fancy; but here at Mycenæ we find objects of precisely that character — goblets, diadems, and even shoulder-straps of gold, artistic pottery of various kinds, and sword blades and daggers inlaid with figures of men and animals made of gold, silver, and other rich material. Similar objects have been found in various parts of the Grecian mainland, and on the islands of the Ægean, so that the civilization they betoken must have been widespread; but where its centre was and what particular race were its representatives are questions still unsettled. The period of its prevalence is still more uncertain, but is vaguely assigned to the interval between 1500 and 1000 B.C.

These questions, and others of equal importance, to which Schliemann's discoveries have given rise, have been discussed by Dr. Schuchhardt in his concluding chapter, and by Mr. Leaf in his introduction. We want to trace the connection of the Mycenæan civilization with the nations of the east and with the later developments among the Greeks themselves, and also to find out the relation between that civilization and the one presented in the poems of Homer. The resemblances between the life revealed to us in the Mycenæan remains and that depicted in the "Iliad" and "Odyssey" are numerous and obvious; but there are also discrepancies which our present information does not allow us to account for, and which seem to show that the poems date from a later age than that of the Mycenæan prime. The most important of these differences is in the mode of disposing of the bodies of the dead, which at Mycenæ were buried, whereas in the "Iliad" and "Odyssey" they are burnt on the funeral pyre. The figures portrayed on some of the ornaments and weapons at Mycenæ also show a mode of dress quite different from that described by Homer; and it is evident that we must have further information before the difficulties thus presented can be cleared up. Meanwhile, we cannot withhold our tribute of admiration and respect for the man who has taught us so much about the life and civilization of those early ages.

Stones for Building and Decoration. By GEORGE P. MERRILL. New York, Wiley. 8°. $5.

THE author of this work is curator of geology in the United States National Museum, and he has succeeded in treating the subject in a way that will make the volume of especial interest to architects and engineers without lessening its value to the student, or, in fact, to any person interested, whether from an economic or a purely scientific standpoint. Though the subject is presented mainly from an American point of view, the volume includes descriptions of all stones of importance found in the American market, from whatever source they may come.

The first chapter gives a brief but very interesting history of stone-working in the United States. The succeeding chapters of Part I. are devoted to the geographical distribution and the chemical and physical properties of such stones as are used for general constructive and decorative purposes.

A systematic description of the rocks, quarries, and quarry regions is given in Part II. Each variety of stone is taken up in turn, its composition, origin, structure, and general adaptability for any form of work discussed, and the resources of each State and Territory described.

The different methods of quarrying and working, the machines and implements used in such processes, the weathering of building-stone, the selection of stone for building purposes, and the methods employed for the protection and preservation of stone from the ravages of time, are treated of in Part III. Part IV. is made up of appendices, including tables showing the qualities of stone as indicated by their crushing strength, with ratio of absorption, and chemical composition; a table on the prices of stone and the relative cost of dressing, and a list of some of the more important stone buildings in the United States and the dates of their erection. The volume concludes with a bibliography of building-stone and a glossary of terms. It is illustrated with eleven full-page plates and several figures in the text.

Mr. Merrill has made excellent use of the opportunities afforded him by his position in the National Museum to gain a thorough knowledge of his subject, and has given us a most exhaustive and comprehensive treatise on an interesting topic.

AMONG THE PUBLISHERS.

A NEW feature has just been introduced in the *New England Magazine*. It is, "In a Corner at Dodsley's," a gossip about writers and books, by Walter Blackburn Harte.

— Macmillan & Co. have been appointed special agents in the United States for the books published in London by George Bell & Sons, including the well-known collection of standard literature issued under the name of "Bohn's Libraries."

— In *St. Nicholas* for October is a short letter from Meredith Nugent explaining where grasshoppers and crickets tried to hide their ears until Sir John Lubbock rummaged them out for us. It would be a knowing boy indeed who would not be surprised to find a grasshopper's ear on his fore-leg.

— Among the contents of the *Engineering Magazine* for October are the following: "Progress in Aerial Navigation," by O. Chanute; "One View of the Keely Motor," by T. C. Smith; "Railroad Building on the Texas Frontier," by G. W. Rafter; "Marble Quarrying in the United States," by E. R. Morse; "The Conditions Causing a Tornado," by Professor H. A. Hazen; and "The Future of Our Wagon Roads," by W. Claypoole.

— The October number of *The Alienist and Neurologist* contains a paper on the subject of "Traumatic Neuroses and Spinal Concussion," another on "The Insanity of Torquato Tasso," an illustrated study of "Criminals and Their Cranial Development," "The Weight of the Brains of the Feeble-Minded," and "A Study of the Heredity of Inebriety." The respective writers are Guiseppe Seppilli, W. W. Ireland, G. Frank Lydston, A. W. Wilmarth, and T. L. Wright. Besides there are the usual selections, editorials, hospital notes, reviews, etc.

— With the issue of the second number of the *Journal of Comparative Neurology*, the editor, C. L. Herrick, indicates the sphere which it will attempt to occupy. The *Journal* offers to investigators an avenue for immediate publication with full illustration, there being no restrictions as to size or frequency of the fascicules. A feature is the list of current neurological literature, which it is hoped may be made complete and accurate, and in connection with this are given synopses of the more important papers. Critical estimates or reviews of such papers, however, will usually be offered only in connection with special *résumés* or digests of given topics. While especially devoted to original investigation, each volume will contain semi-popular, historical, and controversial matter which may serve to adapt the results of the technical work to the general reader. While it is inevitable that much of the space will, for the present, be occupied with anatomical and morphological matter, it is hoped to devote an increasing amount of attention to physiological problems and to the accumulation of data which may serve, in however indirect a way, as materials for a comparative psychology. All observers are invited to contribute facts having any scientific bearing upon the nervous or psychical activities of animals. It is the intention soon to inaugurate a series of articles to constitute, when completed, a laboratory guide to the study of the nervous system, to which the attention of teachers is especially invited, with the request that criticism and suggestion be freely offered. Address all communications to C. L. Herrick, University of Cincinnati, Cincinnati, Ohio.

— Dr. Lansdell is engaged on a volume that will embody the results of his last journey in the East. He travelled over 50,000 miles, visiting Little Thibet and the less-known districts of Chinese Central Asia.

— Messrs. Swan Sonnenschein & Co. will issue the following books during the autumn season: "The Colours of Animals," by Professor Beddard, with colored and other plates and woodcuts; "Text-book of Embryology: Man and Mammals," by Dr. Oscar Hertwig, professor of comparative anatomy in the University of Berlin, translated and edited from the third German edition (with the assistance of the author) by Dr. E. L. Mark, professor of anatomy in Harvard University, with 389 illustrations and 2 colored plates; "Text-book of Embryology: Invertebrates," by Drs. Korschelt and Heider of the University of Berlin, translated and edited by Dr. E. L. Mark, with several hundred illustrations; "Text-book of Animal Palæontology," by Dr. Thomas Roberts, designed as a supplement to Claus and Sedwick's "Text-book of Zoology," illustrated; "Text-book of Geology," adapted from the work of Dr. Emanuel Kayser, professor in the University of Marburg, by Philip Lake of St. John's College, Cambridge, with illustrations; "Text-book of Zoology," by Dr. Claus of the University of Vienna, and Adam Sedgwick, F.R.S., Vol. II. "Mollusca to Man," third edition; "The Geographical Distribution of Disease in England and Wales," by Alfred Haviland, M.D., with several colored maps; "Introductory Science Text-books" — Additions: Introductions to the study of "Physiography," by H. M. Hutchinson; "Zoology," by B. Lindsay; "Amphioxus," by Dr. B. Hatschek of the University of Vienna, and James Tuckey; "Geology," by Dr. Edward Aveling; "Physiological Psychology," by Dr. Th. Ziehen of the University of Jena, adapted by Dr. Otto Beyer, with 21 figures. "Young Collector Series" — Additions: "The Telescope," by J. W. Williams; "British Birds," by the Rev. H. C. Macpherson; "Flowering Plants," by James Britten; "Grasses," by W. Hutchinson; "Fishes," by the Rev. H. C. Macpherson; "Mammalia," by the Rev. H. C. Macpherson.

— The *New England Magazine* for October has an article on "The Public Libraries of Massachusetts," by Henry S. Nourse.

— P. Blakiston, Son, & Co., Philadelphia, have brought out a second American edition of Richter's "Chemistry of the Carbon Compounds, or Organic Chemistry." This new edition is based on the sixth German edition. As is well known, Richter is the professor of chemistry at the University of Breslau. The translation is made by Edgar F. Smith, professor of chemistry at the University of Pennsylvania. Professor Smith is widely known as a translator and as the author of a number of chemical works. Richter's "Organic Chemistry" is one of the most comprehensive books on the subject at present available in English. Not only is the theory

Publications received at Editor's Office, Sept. 30–Oct. 6.

Gilman, N. P., and Jackson, E. P. Conduct as a Fine Art. Boston and New York, Houghton, Mifflin & Co. 230 p. 8°. $1.50.
Gore, J. H. Geodesy (Riverside Science Series). Boston and New York, Houghton, Mifflin & Co. 218 p. 12°. $1.25.
Irving, W. Rip Van Winkle. (Riverside Literature Series). Boston, Houghton, Mifflin & Co. 99 p. 12°. 15 cents.
Macdonald, M. Harmony of Ancient History, and Chronology of the Egyptians and Jews. Philadelphia, Lippincott. 301 p. 8°. $2.
Sadtler, S. P. A Hand-Book of Industrial Organic Chemistry. Philadelphia, Lippincott. 518 p. 4°. $5.

of the science treated, but many methods of preparation of the most important derivatives of the different classes of bodies are given. The new edition contains additions to the methods of analysis described in the first, and naturally due references to the recent advances in chemical theory. The section on carbohydrates has been entirely rewritten and brought into agreement with the present views. Professors Ostwald, von Baeyer, and Emil Fischer aided the author in the presentation of the material drawn from their special fields of investigation. The book will be to some extent available as a text-book, but its considerable size will make it more useful as a guide in the laboratory and as a volume of reference to the advanced student.

— In the *Review of Reviews* each month the pages of small print at the end of the periodical contain classified lists of all the new books that have lately appeared, with bits of running comment on them; lists of the contents of all the principal periodicals of America, England, France, Germany, Italy, Belgium, and the Scandinavian countries; and a complete index, which under one alphabet lists the important articles that have appeared in the previous month in every important periodical published in the English language.

— The opening article of *The Century* for October is the closing one of Mr. Kennan's series, and is entitled "My Last Days in Siberia" He describes his experiences among the Kachinski Taters and the political exiles of Minusinsk, and with the "plague-guard" or quarantine, and narrates the journey by way of Tobolsk and Tiumen to St. Petersburg. The promised article by Hiram S. Maxim, the inventor, on "Aerial Navigation" appears in this number, and considers particularly the question of the power required for aviation. Mr. Maxim discusses the philosophy of the subject and relates the progress of his experiments at Kent, England, which are illustrated with drawings of the machine employed. He also adds a forecast of the possible future uses of the new mode of locomotion.

SCIENCE

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CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

Oct. 18.—Cleveland Abbe, Meteorology in Europe and America; G. E. Curtis, The Rain-Making Experiments in Texas; F. W. Clarke, On the Gem Localities of Maine (with exhibition of specimens).

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—By a young man (27), B.A. and Ph.D., with three years' experience as assistant in chemistry, position as instructor in chemistry or in natural sciences in college or academy, or other advantageous position as chemist. Give particulars as to work, salary, etc. F. W. MAR, L. Box 23, West Haven, Conn.

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For Sale or Exchange for books a complete private chemical laboratory outfit. Includes large Becker balance (200g to 1-10mg.), platinum dishes and crucibles, agate motors, glass-blowing apparatus, etc. For sale in part or whole. Also complete file of *Silliman's Journal*, 1862-1885 (62-71 bound); Smithsonian Reports, 1854-1883; U. S. Coast Survey, 1854-1869. Full particulars to enquirers. F. GARDINER, JR., Pomfret, Conn.

I have five vols. of "Olhausen's Biblical Commentary on the New Testament" that I would like to sell or exchange for works on geology of North America. These volumes are as good as new, except the slight fading of the black cloth covers. D. T. Marshall, Metuchen, N. J.

For sale or exchange, extra fine pair (♂ and ♀) of skins of Rocky Mountain Goat, with the skulls, etc., as needed for mounting; collection of vertebrate fossils from the Coup Fork Tertiary of Kansas; collection of works on descriptive cryptogamic botany—mostly on *Fungi;* thirteen vols. of *Botanical Gazette*, eight vols. *Grevillea*, four vols. *Notarisea;* stereopticon outfit, with attachment for microscopic projection; 148 stereopticon slides, illustrating zoology and cryptogams. Wanted—American and foreign works and pamphlets on Vertebrate Palæontology, and series of *Am. Jour. of Science* and other periodicals containing contributions to Vertebrate Palæontology. Prof. F. W. Cragin, Colorado Springs, Colo.

For exchange or sale at a sacrifice, an elaborate microscope outfit. Bullock stand; monocular objectives, one-sixth homogeneous immersion, four-tenths, and three inch, Bausch & Lomb, also one-fourth and one inch Spencer. Four eye-pieces. Objectives are the best made. Address Mrs. Marion Smith, 41 Branch Street, Lowell, Mass.

SCIENCE

NEW YORK, OCTOBER 16, 1891.

CELESTIAL PHYSICS.[1]

I do not purpose to attempt a survey of the progress of spectroscopic astronomy from its birth at Heidelberg in 1859, but to point out what we do know at present, as distinguished from what we do not know, of a few only of its more important problems, giving a prominent place, in accordance with the traditions of this chair, to the work of the last year or two.

In the spectroscope itself advances have been made by Lord Rayleigh by his discussion of the theory of the instrument, and by Professor Rowland in the construction of concave gratings.

Lord Rayleigh has shown that there is not the necessary connection, sometimes supposed, between dispersion and resolving power, as, besides the prism or grating, other details of construction and of adjustment of a spectroscope must be taken into account.

The resolving power of the prismatic spectroscope is proportional to the length of path in the dispersive medium. For the heavy flint glass used in Lord Rayleigh's experiments, the thickness necessary to resolve the sodium lines came out 1.02 centimetres. If this be taken as a unit, the resolving power of a prism of similar glass will be in the neighborhood of the sodium lines equal to the number of centimetres of its thickness. In other parts of the spectrum the resolving power will vary inversely as the third power of the wave-length, so that it will be eight times as great in the violet as in the red. The resolving power of a spectroscope is therefore proportional to the total thickness of the dispersive material in use, irrespective of the number, the angles, or the setting of the separate prisms into which, for the sake of convenience, it may be distributed.

The resolving power of a grating depends upon the total number of lines on its surface and the order of spectrum in use, about 1,000 lines being necessary to resolve the sodium lines in the first spectrum.

As it is often of importance in the record of observations to state the efficiency of the spectroscope with which they were made, Professor Schuster has proposed the use of a unit of purity as well as of resolving power, for the full resolving power of a spectroscope is realized in practice only when a sufficiently narrow slit is used. The unit of purity also is to stand for the separation of two lines differing by one-thousandth of their own wave-length, about the separation of the sodium pair at D.

A further limitation may come in from the physiological fact that, as Lord Rayleigh has pointed out, the eye, when its full aperture is used, is not a perfect instrument. If we wish to realize the full resolving power of a spectroscope, therefore, the emergent beam must not be larger than about one-third the opening of the pupil.

Up to the present time the standard of reference for nearly all spectroscopic work continues to be Angstrom's map of the solar spectrum, and his scale based upon his original determinations of absolute wave-length. It is well known, as was pointed out by Thalén in his work on the spectrum of iron, in 1884, that Angstrom's figures are slightly too small, in consequence of an error existing in a standard metre used by him. The corrections for this have been introduced into the tables of the wave-lengths of terrestrial spectra collected and revised by a committee of this association from 1885 to 1887. Last year the committee added a table of corrections to Rowland's scale.

The inconvenience caused by a change of standard scale is, for a time at least, considerable; but there is little doubt that in the near future Rowland's photographic map of the solar spectrum, and his scale based on the determinations of absolute wave-length by Pierce and Bell, or the Potsdam scale based on original determinations by Müller and Kempf, which differs very slightly from it, will come to be exclusively adopted.

The great accuracy of Rowland's photographic map is due chiefly to the introduction by him of concave gratings, and of a method for their use by which the problem of the determination of relative wave-lengths is simplified to measures of coincidences of the lines in different spectra by a micrometer.

The concave grating and its peculiar mounting, in which no lenses or telescope are needed, and in which all the spectra are in focus together, formed a new departure of great importance in the measurement of spectral lines. The valuable method of photographic sensitizers for different parts of the spectrum has enabled Professor Rowland to include in his map the whole visible solar spectrum, as well as the ultra-violet portion as far as it can get through our atmosphere. Some recent photographs of the solar spectrum, which include A, by Mr. George Higgs, are of great technical beauty.

During the past year the results of three independent researches have appeared, in which the special object of the observers has been to distinguish the lines which are due to our atmosphere from those which are truly solar — the maps of M. Thollon, which, owing to his lamented death just before their final completion, have assumed the character of a memorial of him; maps by Dr. Becker; and sets of photographs of a high and a low sun by Mr. McClean.

At the meeting of this association in Bath, M. Janssen gave an account of his own researches on the terrestrial lines of the solar spectrum which owe their origin to the oxygen of our atmosphere. He discovered the remarkable fact that, while one class of bands varies as the density of the gas, other diffuse bands vary as the square of the density. These observations are in accordance with the work of Egoroff and of Olszewski, and of Liveing and Dewar on condensed oxygen. In some recent experiments Olszewski, with a layer of liquid oxygen thirty millimetres thick, saw, as well as four other bands, the band coincident with Fraunhofer's A, a remarkable instance of the persistence of absorption through a great range of temperature. The light which passed through the liquid oxygen had a light blue color resembling that of the sky.

[1] Inaugural address at the meeting of the British Association for the Advancement of Science, at Cardiff, August, 1891, by William Huggins, president of the association (Nature, Aug. 20).

Of not less interest are the experiments of Knut Angstrom, which show that the carbonic acid and aqueous vapor of the atmosphere reveal their presence by dark bands in the invisible infra-red region, at the positions of bands of emission of these substances.

It is now some thirty years since the spectroscope gave us for the first time certain knowledge of the nature of the heavenly bodies, and revealed the fundamental fact that terrestrial matter is not peculiar to the solar system, but is common to all the stars which are visible to us.

In the case of a star such as Capella, which has a spectrum almost identical with that of the sun, we feel justified in concluding that the matter of which it is built up is similar, and that its temperature is also high, and not very different from the solar temperature. The task of analyzing the stars and nebulæ becomes, however, one of very great difficulty when we have to do with spectra differing from the solar type. We are thrown back upon the laboratory for the information necessary to enable us to interpret the indications of the spectroscope as to the chemical nature, the density and pressure, and the temperature of the celestial masses.

What the spectroscope immediately reveals to us are the waves which were set up in the ether filling all interstellar space, years or hundreds of years ago, by the motions of the molecules of the celestial substances. As a rule, it is only when a body is gaseous and sufficiently hot that the motions within its molecules can produce bright lines and a corresponding absorption. The spectra of the heavenly bodies are, indeed, to a great extent absorption spectra, but we have usually to study them through the corresponding emission spectra of bodies brought into the gaseous form and rendered luminous by means of flames or of electric discharges. In both cases, unfortunately, as has been shown recently by Professors Liveing and Dewar, Wüllner, E. Wiedemann, and others, there appears to be no certain direct relation between the luminous radiation as shown in the spectroscope and the temperature of the flame, or of the gaseous contents of the vacuum tube — that is, in the usual sense of the term as applied to the mean motion of all the molecules. In both cases the vibratory motions within the molecules to which their luminosity is due are almost always much greater than would be produced by encounters of molecules having motions of translation no greater than the average motions which characterize the temperature of the gases as a whole. The temperature of a vacuum tube through which an electric discharge is taking place may be low, as shown by a thermometer, quite apart from the consideration of the extreme smallness of the mass of gas, but the vibrations of the luminous molecules must be violent in whatever way we suppose them to be set up by the discharge: if we take Schuster's view that comparatively few molecules are carrying the discharge, and that it is to the fierce encounters of these alone that the luminosity is due, then if all the molecules had similar motions, the temperature of the gas would be very high.

So in flames where chemical changes are in progress, the vibratory motions of the molecules which are luminous may be, in connection with the energy set free in these changes, very different from those corresponding to the mean temperature of the flame.

Under the ordinary conditions of terrestrial experiments, therefore, the temperature or the mean *vis viva* of the molecules may have no direct relation to the total radiation, which, on the other hand, is the sum of the radiation due to each luminous molecule.

These phenomena have recently been discussed by Ebert from the standpoint of the electro-magnetic theory of light.

Very great caution is therefore called for when we attempt to reason by the aid of laboratory experiments to the temperature of the heavenly bodies from their radiation, especially on the reasonable assumption that in them the luminosity is not ordinarily associated with chemical changes or with electrical discharges, but is due to a simple glowing from the ultimate conversion into molecular motion of the gravitational energy of shrinkage.

In a recent paper, Stas maintains that electric spectra are to be regarded as distinct from flame spectra, and, from researches of his own, that the pairs of lines of the sodium spectrum other than D are produced only by disruptive electric discharges. As these pairs of lines are found reversed in the solar spectrum, he concludes that the sun's radiation is due mainly to electric discharges. But Wolf and Diacon, and later, Watts, observed the other pairs of lines of the sodium spectrum when the vapor was raised above the ordinary temperature of the Bunsen flame. Recently, Liveing and Dewar saw easily, besides D, the citron and green pairs, and sometimes the blue pair and the orange pair, when hydrogen charged with sodium vapor was burning at different pressures in oxygen. In the case of sodium vapor, therefore, and presumably in all other vapors and gases, it is a matter of indifference whether the necessary vibratory motion of the molecules is produced by electric discharges or by flames. The presence of lines in the solar spectrum which we can only produce electrically is an indication, however, as Stas points out, of the high temperature of the sun.

We must not forget that the light from the heavenly bodies may consist of the combined radiations of different layers of gas at different temperatures, and possibly be further complicated to an unknown extent by the absorption of cooler portions of gas outside.

Not less caution is needed if we endeavor to argue from the broadening of lines and the coming in of a continuous spectrum as to the relative pressure of the gas in the celestial atmospheres. On the one hand, it cannot be gainsaid that in the laboratory the widening of the lines in a Plücker's tube follows upon increasing the density of the residue of hydrogen in the tube, when the vibrations are more frequently disturbed by fresh encounters, and that a broadening of the sodium lines in a flame at ordinary pressure is produced by an increase of the quantity of sodium in the flame; but it is doubtful if pressure, as distinguished from quantity, does produce an increase of the breadth of the lines. An individual molecule of sodium will be sensibly in the same condition, considering the relatively enormous number of the molecules of the other gases, whether the flame is scantily or copiously fed with the sodium salt. With a small quantity of sodium vapor the intensity will be feeble except near the maximum of the lines; when, however, the quantity is increased, the comparative transparency on the sides of the maximum will allow the light from the additional molecules met with in the path of the visual ray to strengthen the radiation of the molecules farther back, and so increase the breadth of the lines.

In a gaseous mixture it is found, as a rule, that at the same pressure or temperature, as the encounters with similar molecules become fewer, the spectral lines will be affected as if the body were observed under conditions of reduced quantity or temperature.

In their recent investigation of the spectroscopic behavior of flames under various pressures up to forty atmospheres, Professors Liveing and Dewar have come to the conclusion that, though the prominent feature of the light emitted by flames at high pressure appears to be a strong continuous spectrum, there is not the slightest indication that this continuous spectrum is produced by the broadening of the lines of the same gases at low pressure. On the contrary, photometric observations of the brightness of the continuous spectrum, as the pressure is varied, show that it is mainly produced by the mutual action of the molecules of a gas. Experiments on the sodium spectrum were carried up to a pressure of forty atmospheres without producing any definite effect on the width of the lines which could be ascribed to the pressure. In a similar way the lines of the spectrum of water showed no signs of expansion up to twelve atmospheres; though more intense than at ordinary pressure, they remained narrow and clearly defined.

It follows, therefore, that a continuous spectrum cannot be considered, when taken alone, as a sure indication of matter in the liquid or the solid state. Not only, as in the experiments already mentioned, such a spectrum may be due to gas when under pressure, but, as Maxwell pointed out, if the thickness of a medium, such as sodium vapor, which radiates and absorbs different kinds of light, be very great, and the temperature high, the light emitted will be of exactly the same composition as that emitted by lamp-black at the same temperature, for the radiations which are feebly emitted will be also feebly absorbed, and can reach the surface from immense depths. Shuster has shown that oxygen, even in a partially exhausted tube, can give a continuous spectrum when excited by a feeble electric discharge.

Compound bodies are usually distinguished by a banded spectrum; but, on the other hand, such a spectrum does not necessarily show the presence of compounds,— that is, of molecules containing different kinds of atoms,— but simply of a more complex molecule, which may be made up of similar atoms, and be, therefore, an allotropic condition of the same body. In some cases — for example, in the diffuse bands of the absorption spectrum of oxygen — the bands may have an intensity proportional to the square of the density of the gas, and may be due either to the formation of more complex molecules of the gas with increase of pressure, or it may be to the constraint to which the molecules are subject during their encounter with one another.

It may be thought that at least in the coincidences of bright lines we are on the solid ground of certainty, since the length of the waves set up in the ether by a molecule, say of hydrogen, is the most fixed and absolutely permanent quantity in nature, and is so of physical necessity, for with any alteration the molecule would cease to be hydrogen.

Such would be the case if the coincidence were certain; but an absolute coincidence can only be a matter of greater or less probability, depending on the resolving power employed, on the number of the lines which correspond, and on their characters. When the coincidences are very numerous, as in the case of iron and the solar spectrum, or the lines are characteristically grouped, as in the case of hydrogen and the solar spectrum, we may regard the coincidence as certain; but the progress of science has been greatly retarded by resting important conclusions upon the apparent coincidence of single lines in spectroscopes of very small resolving power. In such cases, unless other reasons supporting the coincidence are present, the probability of a real coincidence is almost too small to be of any importance, especially in the case of a heavenly body which may have a motion of approach or of recession of unknown amount.

But even here we are met by the confusion introduced by multiple spectra, corresponding to different molecular groupings of the same substance; and, further, to the influence of substances in vapor upon each other; for when several gases are present together, the phenomena of radiation and reversal by absorption are by no means the same as if the gases were free from each other's influence, and especially is this the case when they are illuminated by an electric discharge.

I have said as much as time will permit, and I think indeed sufficient, to show that it is only by the laborious and slow process of most cautious observation that the foundations of the science of celestial physics can be surely laid. We are at present in a time of transition, when the earlier, and, in the nature of things, less precise, observations are giving place to work of an order of accuracy much greater than was formerly considered attainable with objects of such small brightness as the stars.

The accuracy of the earlier determinations of the spectra of the terrestrial elements are in most cases insufficient for modern work on the stars as well as on the sun. They fall much below the scale adopted in Rowland's map of the sun, as well as below the degree of accuracy attained at Potsdam by photography in a part of the spectrum for the brighter stars. Increase of resolving power very frequently breaks up into groups, in the spectra of the sun and stars, the lines which had been regarded as single, and their supposed coincidences with terrestrial lines fall to the ground. For this reason many of the early conclusions, based on observation as good as it was possible to make at the time with the less powerful spectroscopes then in use, may not be found to be maintained under the much greater resolving power of modern instruments.

The spectroscope has failed as yet to interpret for us the remarkable spectrum of the Aurora Borealis. Undoubtedly in this phenomenon portions of our atmosphere are lighted up by electric discharges: we should expect, therefore, to recognize the spectra of the gases known to be present in it. As yet we have not been able to obtain similar spectra from these gases artificially, and especially we do not know the origin of the principal line in the green, which often appears alone, and may have, therefore, an origin independent of that of the other lines Recently the suggestion has been made that the aurora is a phenomenon produced by the dust of meteors and falling stars, and that near positions of certain auroral lines or flutings of manganese, lead, barium, thallium, iron, etc., are sufficient to justify us in regarding meteoric dust in the atmosphere as the origin of the auroral spectrum. Liveing and Dewar have made a conclusive research on this point, by availing themselves of the dust of excessive minuteness thrown off from the surface of electrodes of various metals and meteoroites by a disruptive discharge, and carried forward into the tube of observation by a more or less rapid current of air or other gas. These experiments prove that metallic dust, however fine, suspended in a gas will not act like gaseous matter in becoming luminous with its characteristic spectrum in an electric discharge similar to that of the aurora. Professor Schuster has suggested that the principal line may be due to some very light gas which is present in too small a proportion to be detected by chemical analysis or even by the spectroscope in the presence of the other gases near the earth, but which at the height of the auroral discharges is in a sufficiently greater relative proportion to give a spectrum. Lemström, indeed, states that he saw this line in the silent discharge of a Holtz machine on a mountain in Lapland. The lines may not have been obtained in our laboratories from the atmospheric gases on account of the difficulty of reproducing in tubes with sufficient nearness the conditions under which the auroral discharges take place.

In the spectra of comets the spectroscope has shown the presence of carbon presumably in combination with hydrogen, and also sometimes with nitrogen; and in the case of comets approaching very near the sun, the lines of sodium, and other lines which have been supposed to belong to iron. Though the researches of Professor H. A. Newton and of Professor Schiaparelli leave no doubt of the close connection of comets with corresponding periodic meteor-swarms, and therefore of the probable identity of cometary matter with that of meteorites, with which the spectroscopic evidence agrees, it would be perhaps unwise at present to attempt to define too precisely the exact condition of the matter which forms the nucleus of the comet. In any case the part of the light of the comet which is not reflected solar light can scarcely be attributed to a high temperature produced by the clashing of separate meteoric stones set up within the nucleus by the sun's disturbing force. We must look rather to disruptive electric discharges, produced probably by processes of evaporation due to increased solar heat, which would be amply sufficient to set free portions of the occluded gases into the vacuum of space. May it be that these discharges are assisted, and indeed possibly increased, by the recently discovered action of the ultra-violet part of the sun's light? Lenard and Wolfe have shown that ultra-violet light can produce a discharge from a negatively electrified piece of metal, while Hallwachs and Righi have shown further that ultra-violet light can even charge positively an unelectrified piece of metal. Similar actions on cometary matter, unscreened as it is by an absorptive atmosphere, at least of any noticeable extent, may well be powerful when a comet approaches the sun, and help to explain an electrified condition of the evaporated matter which would possibly bring it under the sun's repulsive action. We shall have to return to this point in speaking of the solar corona.

A very great advance has been made in our knowledge of the constitution of the sun by the recent work at the Johns Hopkins University by means of photography and concave gratings, in comparing the solar spectrum, under great resolving power, directly with the spectra of the terrestrial elements. Professor Rowland has shown that the lines of thirty-six terrestrial elements at least are certainly present in the solar spectrum, while eight others are doubtful. Fifteen elements, including nitrogen as it shows itself under an electric discharge in a vacuum tube, have not been found in the solar spectrum. Some ten other elements, inclusive of oxygen, have not yet been compared with the sun's spectrum.

Rowland remarks that of the fifteen elements named as not found in the sun, many are so classed because they have few strong lines, or none at all, in the limit of the solar spectrum as compared by him with the arc. Boron has only two strong lines. The lines of bismuth are compound and too diffuse. Therefore even in the case of these fifteen elements there is little evidence that they are really absent from the sun.

It follows that if the whole earth were heated to the temperature of the sun, its spectrum would resemble very closely the solar spectrum.

Rowland has not found any lines common to several elements, and in the case of some accidental coincidences, more accurate investigation reveals some slight difference of wavelength or a common impurity. Further, the relative strength of the lines in the solar spectrum is generally, with a few exceptions, the same as that in the electric arc, so that Rowland considers that his experiments show "very little evidence" of the breaking up of the terrestrial elements in the sun.

Stas, in a recent paper, gives the final results of eleven years of research on the chemical elements in a state of purity, and on the possibility of decomposing them by the physical and chemical forces at our disposal. His experiments on calcium, strontium, lithium, magnesium, silver, sodium, and thallium show that these substances retain their individuality under all conditions, and are unalterable by any forces that we can bring to bear upon them.

Professor Rowland looks to the solar lines which are unaccounted for as a means of enabling him to discover such new terrestrial elements as still lurk in rare minerals and earths, by confronting their spectra directly with that of the sun. He has already resolved yttrium spectroscopically into three components, and actually into two. The comparison of the results of this independent analytical method with the remarkable but different conclusions to which M. Lecoq de Boisbaudran and Mr. Crookes have been led respectively, from spectroscopic observation of these bodies when glowing under molecular bombardment in a vacuum tube, will be awaited with much interest. It is worthy of remark that, as our knowledge of the spectrum of hydrogen in its complete form came to us from the stars, it is now from the sun that chemistry is probably about to be enriched by the discovery of new elements.

In a discussion of the Bakerian lecture for 1885 of what we knew up to that time of the sun's corona, I was led to the conclusion that the corona is essentially a phenomenon similar in the cause of its formation to the tails of comets — namely, that it consists for the most part probably of matter going from the sun under the action of a force, possibly electrical, which varies as the surface, and can therefore in the case of highly attenuated matter easily master the force of gravity even near the sun. Though many of the coronal particles may return to the sun, those which form the long rays or streamers do not return; they separate and soon become too diffused to be any longer visible, and may well go to furnish the matter of the zodiacal light, which otherwise has not received a satisfactory explanation. And further, if such a force exist at the sun, the changes of terrestrial magnetism may be due to direct electric action as the earth moves through lines of inductive force.

These conclusions appear to be in accordance broadly with the lines along which thought has been directed by the results of subsequent eclipses. Professor Schuster takes an essentially similar view, and suggests that there may be a direct electric connection between the sun and the planets. He asks further whether the sun may not act like a magnet in consequence of its revolution about its axis. Professor Bigelow has recently treated the coronal forms by the theory of spherical harmonics, on the supposition that we see phenomena similar to those of free electricity, the rays being lines of force, and the coronal matter discharged from the sun, or at least arranged or controlled by these forces. At the extremities of the streams for some reason the repulsive power may be lost, and gravitation set in, bringing the matter back to the sun. The matter which does leave the sun is persistently transported to the equatorial plane of the corona; in fact, the zodiacal light may be the accumulation at great distances from the sun along this equator of such like material. Photographs on a larger scale will be desirable for the full development of the conclusions which may follow from this study of the curved forms of the coronal structure. Professor Schaeberle, however, considers that the coronal phenomena may be satisfactorily accounted for on the supposition that the corona is formed of streams of matter ejected mainly from the spot zones with great initial velocities, but smaller than 382 miles per second; further, that the different types of the corona are due to the effects of perspective on the streams from the earth's place at the time relatively to the plane of the solar equator.

Of the physical and the chemical nature of the coronal matter we know very little. Schuster concludes, from an examination of the eclipses of 1882, 1883, and 1886, that the continuous spectrum of the corona has the maximum of actinic intensity displaced considerably towards the red when compared with the spectrum of the sun, which shows that it can only be due in small part to solar light scattered by small particles. The lines of calcium and of hydrogen do not appear to form part of the normal spectrum of the corona. The green coronal line has no known representative in terrestrial substances, nor has Schuster been able to recognize any of our elements in the other lines of the corona.

(To be continued.)

NOTES AND NEWS.

RECENT additions to the stock of Geo. L. English & Co., the well-known mineralogists, have been so extensive that they have been compelled to issue a supplement to their "Catalogue of Minerals." "Supplement A" contains 20 pages well filled with descriptions of new specimens procured in different parts of the world by the three collectors who have been at work during the summer.

— "As I went to the train one morning," writes a correspondent of *Nature*, "I saw a brown retriever dog coming full speed with a letter in his mouth. He went straight to the mural letter box. The postman had just cleared the box, and was about twenty or thirty yards off when the dog arrived. Seeing him, the sagacious animal went after him, and had the letter transferred to the bag. He then walked home quietly."

— Dr. Loewenberg of Paris discusses the influence of sex in what he calls the "lateralization" of ear disease. After referring to the view generally held by otologists that the left ear is more liable to be attacked alone, or to be attacked first and to suffer more severely when both ears are affected, he says, according to the *British Medical Journal*, that he has for a long time past been struck with the fact that, while deafness is more common on the left side in men, the same does not hold good in the case of women. From statistics of 3,000 cases (not including diseases of the concha and external meatus) which have come under his own notice, he shows, in the first place, that the male sex is more subject to ear disease than the female, there having been 1,790 of the former to 1,210 of the latter. Among those in whom only one ear was affected there were 478 men and 311 women. The right ear alone was affected in 212 men and 167 women; the left alone in 266 men and 144 women. Deafness existed in both ears in 1,074 men and 737 women. Among this number the right ear was the more deaf of the two in 427 men and 340 women, the left in 647 men and 397 women. Deafness was equal on both sides in 238 men and 162 women.

— The Ohio State University opened the fall term on Sept. 16, with a more than usual increase of attendance. In the agricultural and veterinary departments the number is over thirty per cent larger than last year, and the increase of the various departments together is much larger than any previous year. This is probably due to the passage of the Hysell bill last year, which brought the institution before the minds of the people, and also put it beyond financial embarrassment. In addition to the nine buildings now in use, the ground will be broken this fall for two more large buildings,— one for the manual training school and the other for the museum and library. Several full professors have been added to the faculty, besides a number of assistants. The School of Law, which is a new department, opened its first session on Oct. 1, at the Franklin County Court House in Columbus, where students will have unusual facilities for observing the organization and working of courts, the actual progress of trials, etc. The new school starts out in a way that promises prosperity. The biological club held its first meeting of the term on Sept. 22, when interesting reports of the summer's work were submitted by the members. Several new members were elected, among them W. A. Kellerman, professor of botany in the university, and Professor F. M. Webster, entomologist at the Experiment Station. Both are valuable acquisitions to the club, each having travelled and done biological work both at home and abroad.

— The monthly report of the State Geologist of Missouri states that during September detailed mapping has been continued in Henry and St. Francois counties, and, in the former, most excellent progress has been made. In all, some one hundred and fifteen square miles have been covered. The mapping of the crystalline rocks in the south-east, and of the other geological formations in Webster, Greene, and Christian Counties has been actively pushed, and nearly two hundred square miles have been completed during the month. Inspections of iron ore deposits have been made in Reynolds, Texas, Wright, Douglas, Christian, Taney, Greene, Lawrence, Franklin, Gasconade, Howell, Jasper, and Laclede Counties. The results of this work so far indicate that the extent of the limonite ores of the southern part of the State is much greater than has been anticipated, and that there is a promising outlook for the development of manganese ores in this region. Inspections of lead and zinc deposits have been made in Polk, Dade, Taney, Laclede, Phelps, Douglas, Marion, and Franklin Counties. The quaternary deposits have been studied in Cape Girardeau, St. Louis, Franklin, Marion, Pike, Lincoln, St. Charles, Livingston, Chariton, Daviess, and Buchanan Counties. Good progress has been made in the preparation of the report on the paleontology of the State. Some two hundred and forty pages of manuscript are already written, and arrangements are about completed for the engraving of the plates to accompany the volume. The preliminary reports on the coal deposits of the State is nearly completed, and much time has been spent during the past month on the preparation of the manuscript and illustrations for it, and the draughting of detailed maps and sections preparatory to engraving has continued uninterruptedly.

— Queen & Co., Philadelphia, will, in a short time, transfer their entire plant, now located at 924 Chestnut Street, to the larger building, 1010 Chestnut Street. The public of Philadelphia speak of Queen's as "opticians," and comparatively few outside of the professional world are aware of the magnitude of their business. A brief description of each department may be of interest. Department No. 1 is devoted to spectacles, eye-glasses, opera glasses, field and marine glasses, and apparatus for oculists, including ophthalmoscopes, trial glasses, perimeters, etc. Department No. 2 is devoted to instruments of precision required by engineers, architects, draughtsmen, students, and others. No. 3 is for microscopes and all instruments which are allied to the microscope. From this department comes the *Microscopical Bulletin*. No. 4 is one of the most extensive and interesting. Here are to be found the various apparatus required in the physical laboratories of schools and colleges. No. 5 is devoted to magic lanterns, or, in scientific terms, apparatus for luminous projection, views, and accessory apparatus. Spy-glasses, astronomical telescopes, and solar transits are also included. No. 6 includes meteorological instruments. This department recently supplied the United States War Department with the Boulangè chronographs for determining the velocity of projectiles. No. 7 is the photographic department. Every effort will be made to have this department attractive in the new building. Dark rooms for developing, etc., will be provided, and competent instructors will be on hand to show the would-be photographer "how to do it." This department gives especial attention to the photographing of buildings, country seats, vessels, machinery, and to the developing and printing of exposures made by amateurs and others. In addition to these departments, Queen & Co. operate three factories and a brass foundry. Their largest factory is devoted to the manufacture of the various instruments of precision. Another factory is for the manufacture of thermometers only. The optical factory is for the manufacture of spectacles, eye-glasses, lenses, etc. They employ in the neighborhood of two hundred hands in the various departments of their business.

— Three letters from Alexander Agassiz, published in the Bulletin of the Museum of Comparative Zoology, give some interesting particulars of the expedition of the "Albatross" The deep-sea fauna in the neighborhood of Panama is poor compared to that of the eastern shores of the continent. Probably this poverty is due to the absence of a great oceanic current, bringing supplies of food. West Indian forms preponderate. The southern slope of the Galapagos also did not yield the rich fauna that was expected, though it lies in the track of a great current from the south. A gigantic ostracod, more than an inch long, was dredged up between Cape San Francisco and the Galapagos and also in the Gulf of alifornia.

— Mr. John Bogart, State Engineer of New York, has sent in a report concerning the recession of Niagara Falls. In 1842 Professor James Hall made an accurate survey, and a comparison of his results with those of 1890, made in a bulletin of the American Geographical Society, shows that the annual recession at the American Fall has been 7.68 inches, and at the Canadian, or Horseshoe Fall, 2 feet 2.16 inches. During this period the crest line of the American Fall has sunk from 1,080 to 1,060 feet, and that of the Canadian has risen from 2,260 to 3,010 feet. The area of rock which has been carried away during those forty-eight years is 32,900 square feet at the American Fall and 275 400 square feet at the Canadian Fall.

— Sparrows do not seem to lose in New Zealand any of the audacity for which they are famous in Europe, says *Nature*. In a paper read some time ago before the New Zealand Institute, and now printed in the Transactions, Mr. T. W. Kirk gives an example of what he calls their "daring and cool impudence." Between Featherston and Martinborough he heard one day a most unusual noise, as though all the small birds in the country had joined in one grand quarrel. Looking up, he saw a large hawk (*C. Gouldi* — a carrion-feeder) being buffeted by a flock of sparrows. They kept dashing at him in scores, and from all points at once The unfortunate hawk was quite powerless; indeed, he seemed to have no heart left, for he did not attempt to retaliate, and his defence was of the feeblest. At last, approaching some scrub, he made a rush indicative of a forlorn hope, gained the shelter, and there remained. Mr. Kirk watched for fully half an hour, but he did not reappear. The sparrows congregated in groups about the bushes, keeping up a constant chattering and noise, evidently on the look-out for the enemy, and congratulating themselves upon having secured a victory.

— Some interesting observations relating to the surgical treatment of wounds by birds were recently brought by M. Fatio before the Physical Society of Geneva. According to the *Medical Record*, he quoted the case of the snipe, which he had often observed engaged in repairing damages. With its beak and feathers it makes a very creditable dressing, applying plasters to bleeding wounds, and even securing a broken limb by means of a stout ligature. On one occasion he killed a snipe which had on the chest a large dressing composed of down taken from other parts of the body and securely fixed to the wound by the coagulated blood. Twice he had brought home snipe with interwoven feathers strapped on to the site of fracture of one or other limb. The most interesting example was that of a snipe both of whose legs he had unfortunately broken by a misdirected shot. He recovered the animal only on the day following, and he then found that the poor bird had contrived to apply dressings and a sort of splint to both limbs. n carrying out this operation some feathers had become entangled around the beak, and not being able to use its claws to get rid of them, it was almost dead from hunger when discovered. In a case recorded by M. Magnin, a snipe which was observed to fly away with a broken leg was subsequently found to have forced the fragments into a parallel position, the upper fragments reaching to the knee, and secured them there by means of a strong band of feathers and moss intermingled. The observers were particularly struck by the application of a ligature of a kind of flat-leafed grass wound round the limb, of a spiral form, and fixed by means of a sort of glue.

— There are three electrolytic processes now in commercial operation for the production of aluminum. These, as described in *Engineering*, are the Hall process, worked by the Pittsburg Reduction Company; the Heroult process, worked by the Aluminum Industrie Actien Gesellshaft, at Neuhausen, Switzerland, and by the Sociéte Electro-Metallurgique de France at Froges; and the Minet process, used at the works of Bernard Brothers, at Creil, France. The two former processes, and the works where they are carried on, have been fully described within the last year. The last consists in electrolyzing a mixture of sodium chloride with aluminum fluoride, or with the double fluoride of sodium and aluminum, and is being carried out successfully. The metal ordinarily sold contains two to three per cent of impurities,— generally silicon and iron,— and is usually benefitted by the presence of the former, as it adds hardness and strength. Aluminum becomes pasty at about 1,000° F., and melts at 1,300°. It loses much of its tensile strength at 400° to 500° F, at which temperature it anneals. The coefficient of linear expansion under heat when of 98.5 per cent purity is .0000206 per degree Centigrade between the freezing and boiling points of water. This nearly corresponds with the expansion of tin, which is .0000217. The specific heat is .2143, and the thermal conductivity 73.6, silver being taken as 100 Recently a way of soldering aluminum has been discovered, with hard and soft solder, and with an alloy of zinc and aluminum. The nature of the soldering fluid has not yet been published. The shrinkage of aluminum in casting is $\frac{15}{64}$ of an inch per foot, or about 2.26 per cent of the length of the mould.

— MM. Rousson and Willems have completed the exploration of the northern extremity of the main island of Tierra del Fuego, and have communicated the results to the French Minister of Instruction (*Compte Rendu* of the Paris Geo. Soc., Nos. 7 and 8, 1891). The part referred to is bounded towards the south by a line drawn from Useless Bay to the Bay of San Sebastian. It is traversed by a chain of mountains, which rises suddenly at Cape Boqueron to a height of 1,600 feet, and terminates at Cape Espiritu Santo. The rest of the country, according to the *Scottish Geographical Magazine*, consists of great plains watered by numerous rivers, many of which dry up in summer. The most important is Rio del Oro, which flows into Philip Bay. Tierra del Fuego has a great variety of climates, but on the whole the cold is not as severe as might have been expected. The lowest temperature observed was 43° F., and the highest 69°. The nights are always cold. The barometer is subject to very sudden and considerable changes, and the winds are frequent and violent, those from the west often attaining a velocity of nearly a thousand feet per second. The Onas, who inhabit the northern part of the island, are very tall, sometimes six feet six inches, or more, in height. They are copper-colored, have oval faces and long hair plastered with clay, small eyes, prominent cheek bones, large mouths, and a few hairs on the chin. Their only clothing is a cape of guanaco or fox skin, and, sometimes, a triangular covering of leather on the head. The men occupy themselves solely in fighting with their neighbors and hunting, their chief weapons being bows and arrows tipped with pieces of glass, found on the shore, or flint. All the household labor falls on the women. Their encampments consist of circular holes, five feet in diameter and sixteen inches deep, dug out of the side of a mountain, with stakes set up round them to support a covering of skins. The Onas are not cannibals, as some travellers have asserted; nor do they burn their dead. The native population cannot be estimated at more than three hundred, but in summer the number of inhabitants is largely increased by miners, who return to Punta Arenas in winter. The flora of the country is poor, no trees growing in the north of the island and but few shrubs. Quadrupeds are scarce, the principal being the guanaco, dog, fox, and one or two small rodents, but snipe, ducks, geese, owls, swans, and other birds are plentiful. Magnetic iron is widely distributed and in large quantities, and gold, mixed with very small garnets and rubies, is found in several places. There are also some coal seams of very poor quality, and abundance of clay suitable for the manufacture of earthenware. It is probable that the land will in time be taken up for grazing purposes. Within the last few years several small farms have been established and have yielded large returns. On Dawson Island the Jesuits have a model farm, where nearly 20,000 sheep and more than 6,000 cattle are fed.

— It is stated by *Engineering* that half the tin of the world is exported from the Malay Peninsula, where mining is carried on almost entirely by Chinese. The mining is that of flood tin, and the metal is taken from the lowlands near the mountains, where it is found in pockets ten to twenty feet or more below the surface.

— Mr. W. Mattiere Williams, in a letter to *Nature* of Oct. 1, writes as follows: "On two occasions, when proceeding northwards to Arctic Norway, I was much interested in observing the fact that the plague of mosquitoes, which is so intolerable there, especially prevails in latitudes beyond the northern range of the swallow. This may possibly be a mere coincidence, but I think it is not — an opinion strongly supported by another and very broad fact, viz., that in a given district in our own country the gnats become more abundant immediately after the departure of the swallows, martins, etc. If this view is correct, the protection of these birds should be added to the devices named in 'Dragonflies *vs.* Mosquitoes.'"

— On his return to Germany from Japan sixteen years ago, Professor Rein, the well-known authority on Japanese art and industry, planted in the Botanical Garden at Frankfort some specimens of the lacquer tree (*Rhus vernicifera*), from which the Japanese obtain the juice employed in the production of their famous lacquer work. According to the London *Times*, there are now at Frankfort thirty-four healthy specimens of the lacquer-tree, thirty feet high and two feet in girth a yard from the ground; and the young trees, which have sprung from the original tree's seed, are in a flourishing condition. It seems to be proved, therefore, that the lacquer-tree is capable of being cultivated in Europe, and it only remains to be seen whether the juice is affected by the changed conditions. The *Times* says that, to ascertain this, Professor Rein has tapped the Frankfort trees, and has sent some of the juice to Japan, where it will be used by Japanese artists in lacquer work, who will report on its fitness for lacquering. In the mean time, some of the most eminent German chemists are analyzing samples of the juice taken from the trees at Frankfort, and samples of the juice sent from Japan; and should their reports and the reports from Japan be favorable, it is probable that the tree will be largely planted in public parks and other places in Germany. In course of time a skilled worker in lacquer would be brought over from Japan to teach a selected number of workmen the art of lacquering wood, and in this way it is hoped that a new art and craft may be introduced into Europe.

— The disposal of sewage is a question which has been to the fore for a good many years in various countries, says *Engineering*, but which, perhaps, nowhere on the Continent has been dealt with in a more systematic manner than in Germany. In Berlin the drains from the houses receive both the rain water, the dirty water from the kitchen, etc., and the contents of the water closets, conducting them to a system of radial sewers, through which they, by a natural fall, proceed to a dozen various pumping stations within the area of the town. From these the sewage, through the medium of combined force and suction pumps, passes through pipes of three feet or still greater diameter to the land which the corporation of Berlin possesses, and where the sewage is used as a fertilizer. The sewage makes its final exit through a system of conduits so arranged that before reaching them it has parted with all its manurial power to the soil through which it is made to pass. The sewage water thus filtered reaches the river through the natural fall of the conduits in a comparatively purified state. The sewage is an exceptionally good manure, and the yield of grass on those fields that receive it is something quite out of the common, so that it can be cut some six or seven times during one summer. This system also seems to answer well so far as the sanitary side of the question is concerned, but still there are a good many places which prefer the method by which the sewage is collected in large tanks, whereby it is possible to benefit larger areas by its fertilizing qualities. Frankfort-on-the-Maine is another German town where the sewerage system is very perfect, but owing to the excessive cost of land in that locality the sewage is not, as in Berlin, used as manure in the first instance. The sewage is purified before being allowed to escape into the Maine, and the residue is pumped into receptacles from where the farmers fetch it. The town of Hanover is also about to adopt the sewerage system on a larger scale. In Augsburg and Heidelberg the barrel system is used, much more satisfactory in the latter than in the former town. In Heidelberg the corporation itself attends to the emptying of the barrels.

— Cloud heights and velocities form the subject of a recent article by Mr. H. H. Clayton in the *American Meteorological Journal*. The paper contains the result of cloud observations made at Mr. A. L. Rotch's observatory at Blue Hill, Mass., during the past five years. The average heights of some of the principal clouds were: Nimbus, 412 metres; cumulus, base, 1,558 metres; false cirrus, 6,500 metres; cirro-stratus, 9,652 metres; cirrus, 10,135 metres. The cumulus is highest at Blue Hill during the middle of the day. The Upsala observations show that the base of the cumulus, as well as the cirrus, increases in height until evening, but neither of these conclusions apply to the observations at Blue Hill. The average velocity found for the cirrus, 82 miles an hour, is twice as great as that found at Upsala. The extreme velocity was found to be 133 miles an hour. A comparison between wind and cloud velocity shows that below 500 metres the wind velocity is less than the cloud velocity. Above that, the excess of the cloud velocity increases up to 1,000 metres, and then decreases again till about 1,700 metres, after which it steadily increases. This decrease between 1,000 metres and 1,700 metres is very probably due to the fact that the clouds between 700 metres and 1,000 metres were mostly observed during the morning, when the cumulus moves most rapidly, and that the clouds between 1,000 metres and 1,700 metres were mostly observed during the afternoon, when the cumulus moves slowest.

— Dr. Borden P. Bowie of Boston University, who has charge of the philosophical department, is now preparing a work on logic. The manuscript is nearly ready for the printers.

— Professor Conn, the head of the biology department of Wesleyan University, Middletown, Conn., has his latest book, "The New World" ready for the press, and it will be issued very soon.

— Professor George S. Bryant of the Alabama Polytechnic Institute has been appointed director of the workshop and assistant professor of mechanical engineering in the Leland Stanford, jun., University.

— Several changes have been made in the faculty of Vassar College, the following new teachers having been added: Professor J. C. Bracq, professor of French; Miss Neef, assistant in French and German; Professor J. L. Moore, professor of Latin; Miss Byrnes, assistant in biological laboratory; Miss Ballantine, director of gymnasium. Mrs. Georgia Kendrick is lady principal.

— Professor George Francis James of the University of Nashville has been appointed lecturer on literature in the University of Pennsylvania and editor of *University Extension*, the official organ of the American Society for the Extension of University Teaching. Mr. James was a student of the Northwestern and Michigan Universities and has done post-graduate work in the University of Halle, Germany, and in the Sorbonne at Paris. Two years ago he gave up the principalship of the Decatur (Ill.) high school to go to Nashville, from which position he has been called to Philadelphia.

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and one hundred copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

APPLE AND PEAR SCAB.

THE microscope has revealed the fact that the brown scab which has become so prevalent on certain varieties of apples and pears during recent years is itself a plant, reproducing itself by spores, which are borne upon the wind and find their congenial soil in the leaves, tender twigs, and fruit of the apple and pear.

When the nature of the pest was ascertained a remedy was suggested in the treatment which has recently been discovered to be so effective in the case of other fungoid diseases of plants, namely, the spraying of the affected trees with a solution of copper sulphate. This treatment has been recommended by the national Department of Agriculture for several years; but, as heretofore practiced, it has often injured the foliage of the trees to such an extent that the remedy was almost as bad as the disease.

The Ohio Experiment Station has this season conducted an extensive series of experiments, some on its own grounds, some in a large orchard in the neighborhood leased for the purpose, some in the fruit region of the lake shore, and some in orchards along the Ohio River. In these experiments several preventive solutions have been tried, but especial attention has been given to the question whether the strength of the copper sulphate and lime solution (known as the Bordeaux mixture) might not be reduced so as not to injure the foliage and yet accomplish the object of preventing disease. The results of this work were shown in a striking exhibit, made at the State fair and other places, in which sprayed fruit was shown to be almost absolutely free from disease, while that from neighboring trees left unsprayed was almost worthless.

The spraying not only reduces the injury to the fruit, but it largely increases the total crop. This is because the foliage on the sprayed trees remains healthy, while on the unsprayed trees it is diseased and unable to perform its functions. Furthermore, the scabby fruits fail to develop to their normal size, because of the scab that is on them. The sprayed apples are fully twenty-five per cent larger than the unsprayed, and are more highly colored. As might be expected, the sprayed apples sell for more than the unsprayed, there being a difference of more than twenty-five per cent in favor of the former. This was found to be the case by an actual test in the market, the sprayed apples selling more rapidly at fifty cents per bushel than the unsprayed at forty cents. This makes a total gain in favor of spraying of fully fifty per cent. The cost per tree for the season does not exceed twenty-five cents, while there is often a gain of one dollar or more, depending largely upon the variety, as some are much more subject to scab than others. Spraying also prevents the premature falling of the leaves, which is one of the results of the scab, for it affects the leaf as well as the fruit.

Following are the formulæ used in these experiments: No. 1 — copper sulphate, 4 pounds; lime, 4 pounds; water, 1 barrel. No. 2 — copper sulphate, 4 pounds; lime, 4 pounds; Paris green, 4 ounces; water, 1 barrel.

No. 1 is used for apple and pear scab, and to prevent the leaves of plum and pear trees from dropping prematurely; also, for raspberry cane scab, or anthracnose. Apply once before the leaves open and about three times thereafter. It should not be used on plums and early fruits later than July 1, and it is not necessary to use it on any fruit later than Aug. 1. It should not be used on raspberries after the blossoms open, and care should be taken to direct the spray to the young growth and avoid the old canes after the first application.

No. 2 is used on pear, apple, plum, and cherry trees after the blossoms fall, for the purpose of destroying insects. On plum and cherry trees the applications should be made once in two weeks, and oftener if the weather is rainy, up to within six weeks of the time of ripening. For the last application on these fruits, it would be well to dilute the mixture one half, or more, so as to avoid lime coating; or the following may be substituted: Paris green, 2 ounces; copper carbonate, 2 ounces; dissolve in three pints of ammonia; add half a pound of lime and one barrel of water.

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.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The Man of the Future.

DOCTOR LANGDON'S remarks in a recent issue of *Science* (No. 452) on the probable further evolution of man is one full of interest to every speculative anthropologist. To the present writer it is evident that man has by no means arrived at the acme of his development, either mentally, morally, or physically; indeed, I conceive the entire genus *homo* to be but little more than just started upon its career of evolutionary growth.

In the first place there are many species and sub-species of men upon the face of the globe of very low type that will either have to be, or will be, exterminated in time by some branch of what ultimately will persist as the dominant race. As examples, we may point to the pygmies of Africa, many of our North American Indians, and similar ferine tribes. Some of these, however, will undoubtedly to a certain extent fuse with the root-stocks of the dominant race; some may be assimilated entirely,—a fate that seems to await the negroes of the United States, and perhaps later the Japanese and others. In short, I am inclined to think that, in the ages to come, the human species of this world will eventually tend to form one homogeneous race, and that race will speak but the one language. When that epoch has fully arrived, then indeed will the human species be fairly on the road towards its perfection. Multifarious tongues now stand as a prime factor in the way of man's more rapid evolvement. All this will require an enormous lapse of time, and when it arrives the face of the earth will be greatly changed. Man will have subordinated all things to his will,—and nearly all other forms now existing, with the exception of the very few that may prove useful to man, will have been completely exterminated.

Many of these changes are now slowly advancing under our very eyes. Take the ideal man of the present day,—one of the most perfectly organized ones as they now exist, and what do we find? In the vast majority of cases, as Clevenger has shown, he is still subject to a variety of diseases which arise from the fact that within a comparatively recent time of the world's history he has assumed the erect attitude; has passed from quadrupedal to bipedal locomotion. Often these diseases prove to be fatal,—as prolapsus uteri, the hernias, and others: is there to be no improvement along this line? Again, he has still clinging to his organization many of the structural vestiges that link him with the brutes: is there to be no improvement in that direction? It has been proven that modifications are taking place in his dental armature, his dermal appendages (as the hair disappearing, and so forth), and perhaps to some extent in his very form, due to dress, as encasing the feet, and strapping certain parts of the body. Will these causes not, if continued, produce their ultimate effects?

However daintily he may mask the animals he kills and devours, he is still as carnivorous as most of the *Felidæ*. He often settles his disputes by the murder of masses of his kind, and the leaders in such assaults are glorified by having monuments erected to them in the high places. In these days such monuments are seventy-five per cent more numerous than are those erected to the great among men of letters, of science, the arts, and the industries. All of this savors very strongly of savagery, and can hardly be characteristic of a fully developed race of men.

This aspect is not improved when we come to think of the vast number of what many in the world would reckon as our best developed specimens of men, whose minds are still controlled by the nursery myths, the miracles, and the fables that were told and sung to the children of the early peoples of the world in Asia. Is the mind of the man of the future to remain in such a condition of thraldom? In fact, the most of the opinions held, the institutions, the very language, the entire organization by and of the best existing types of men, are each and all to me highly indicative of a very early stage of the development of the species.

So I cannot fully coincide with Dr. Langdon when he says, "While, therefore, we may anticipate an increase in the average perfection of parts, and consequently a more harmonious development of man's present plan of structure, we cannot rationally look for any radical change in the plan itself." Although it would not demand any radical change in the *plan* of structure of present man, has it ever occurred to your correspondent that in the dim future of the world the *environment* of man may have progressively so changed as ultimately to produce a race of enormous giants; or, other conditions obtaining, a race of the veriest pygmies may be the result? Who among our present-day naturalists, had he lived in Eocene time, and become familiar with the little *Eohippus*, no bigger than a fox, would ever have predicted that from it was in time to be developed the highly modified modern horse? It is safe to say, not one, — yet *Eohippus* must have appeared quite perfect for its kind in its day.

There is every reason to believe that in the lapse of time, or when many more millions of years have rolled by, our little earth will become cold from changes now going on: she may solidify to her very core, and become as frigid as a moon, and utterly incapable of supporting any manner of life upon her surface. In fact, life will probably be at an end long before any such condition in her comes about. The last one of the human species, the very last individual of all, the very tip of the last twig of the tree of human descendants, must also die, — perish. If that modified form possesses sight, its eye may look out upon a remarkable scene indeed. Earth may be stripped of all timber; coal beds all burned up; metals all moulded into medallions, machines, and monuments; her land-surface graded nearly or quite level by causes now in operation; every other living thing, every lion, lark, and louse in the land exterminated; and nothing remaining but the works of the modified man. R. W. SHUFELDT, M.D.

Takoma, D.C., Oct. 9.

Rain-Making.

IN *Science* for Oct. 9 Mr. Powers takes exception to a short discussion of this question prepared by myself and published in August. I have no desire to enter the discussion, but simply to correct one or two misapprehensions of my own connection with this matter. Mr. Powers gives a novel view of Plutarch's statement regarding battles and rain. The following is a translation of Plutarch: "Extraordinary rains generally fall after great battles." He is doubtful whether by these the gods would wash out the trouble from the sky "or the blood and corruption, by the moist and heavy vapors they emit, thicken the air, which is liable to be altered by the smallest cause." It hardly seems as though this corresponds with the later view of Mr. Powers. But the view of another rain-maker does not agree with that of Mr. Powers "Let 10,000 Greeks march into battle chanting their 'paeans' and shouting their 'allallas,' beating time meanwhile on their shields, while 100,000 Persians are advancing against them, continually shouting their terrible battle-cries; then let the great armies rush together with the tumult of clashing swords and shields, the hoarse death-cries and shouts of victory, and surely the sound-waves rising from such a din will literally shake the heavens, and are capable of producing no insignificant effect among the volatile currents of the upper air. Moreover, the heat generated from the struggling masses and the moisture evaporated from their perspiration would exercise a decided influence in disturbing the equilibrium of the atmospheric conditions."

Exception is taken to my very guarded statement, "During the war of the Rebellion there were over 2,200 battles, on an average *probably* as severe as the average of the 158 above mentioned" (by Mr. Powers). I have italicized a very important word. I had no time to do anything more that compare several of the running statements of the battles given in the old edition of "War and the Weather" with other facts. This I did sufficiently to satisfy myself that such a statement could be made. It is an open question in my mind just how one should treat a continued battle and firing in studying its probable effect upon the atmosphere. The more or less desultory firing in many battles could not be considered as of much importance. Moreover, any rain which fell after an interval of a few minutes must probably be regarded as in no wise due to the explosions. I do not say that the smoke and carbon from the powder might not have some influence, but whatever they had would be felt a hundred miles or more from the scene of the explosions.

Mr. Powers thinks that the currents of the atmosphere do not travel at the rate of twenty to fifty miles per hour, or, at least, during these battles they did not do so. This is a question of fact which has been proved by actual observation, and cannot be gainsaid. The only time these currents are not moving with this velocity is when a high area or "clearing condition" is passing. Mr. Powers's theory of storm formation is exceedingly unique, and possibly he could help meteorology by establishing that theory. What he would need to do would be to select a high area or a "clearing condition," and then make his explosions and note the result. It certainly is not a fact that two currents pass in opposite directions near the point of formation of our storms. Mr. Powers takes exception to my statement, "One thing seems very evident, that absolutely no rain can be obtained out of a dry atmosphere." I will now take out the word "seems" which has no business in this statement, and leave the rest without fear of contradiction by any one who reads the expression as I meant it.

H. A. HAZEN.

Washington, D.C., Oct. 12.

BOOK-REVIEWS.

Laboratory Practice. By JOSIAH PARSONS COOKE, LL.D. New York, Appleton. 16°. $1.

ALL students of chemistry are familiar with "The New Chemistry," by Professor Cooke, the first edition of which appeared eighteen years ago, when it was one of the earlier volumes of the International Scientific Series. That book, which has fascinated so many, now appears in a revised and enlarged form. The book now issued is described by the author as a "companion volume to 'The New Chemistry.'" As will be remembered, the earlier book was largely descriptive of the problems and theoretical discussions of modern chemistry. "Laboratory Practice" gives a series of experiments on the fundamental principles of chemistry. The purpose of the author is to furnish the beginner in chemistry with a text-book which shall aid him in doing his laboratory work, but only when this work is carried out under the guidance of a competent teacher, — a teacher who can speak to the students from the fulness of his own knowledge. Professor Cooke, as the head of the chemical department of Harvard College almost as long as there has been such a department — for more than forty years — has had great experience as a teacher of chemistry, and it is certain that each and all of those who have had the pleasure of taking courses under him can testify that he could always speak from the fulness of his knowledge. It has seemed in perusing this new book that the author did not always appreciate that others had not equal experience, and to those who find descriptions of apparatus difficult to follow without the aid of illustrations, their almost total absence may be disappointing. But it is enough to say that Professor Cooke has brought out this new book to make sure that all teachers of chemistry will be anxious to examine it.

Eighty-odd experiments are described, some of them, owing to the modern developments, of a physical rather than of a chemical nature as formerly understood. The apparatus called for is not expensive, and can be rendered even less so by resort to various make-shifts, which are, however, always bothersome and time-consuming.

Conduct as a Fine Art. The Laws of Daily Conduct, by NICHOLAS P. TILMAN; *Character Building,* by EDWARD P. JACKSON. New York, Houghton, Mifflin & Co. 12°. $1.50.

SOME time since the American Secular Union of Philadelphia offered a prize of one thousand dollars for the best treatise for teaching morals in the public schools without inculcating any religious doctrine, and the prize was divided between the authors of the two works here named. They are quite different in literary form, Mr. Gilman's being an essay in several chapters, and Mr. Jackson's a series of conversations between a teacher and his pupils. Religion as a basis of morality having been set aside, it is held to be necessary to give it a "scientific basis;" and Mr. Gilman in particular makes special claims for his work on this account. After a careful reading of it, however, we are unable to find any scientific quality in it. The only way to make ethics scientific is to find the ultimate ground or criterion of right and wrong, and then deduce all minor principles from this fundamental one. But Mr. Gilman expressly repudiates any design of doing so, apparently because he has no settled opinion as to what the criterion is. Nor is there anything scientific in the arrangement of his work; on the contrary, it is a series of desultory chapters which might just as well have been arranged in any other way. Mr. Jackson makes much less pretension of being scientific; but after reading both works we can readily understand the statement in the preface that the society that offered the prize was not satisfied with either of them.

But in saying these things we do not wish to be understood as condemning the essays, either of them. They present the common-sense ethics of the time in a form suitable for instructing children, and in the hands of good teachers may be made useful. They are intended rather for teachers than for pupils, it being supposed that the teacher will instruct his pupils orally; and teachers of strong moral instincts who are also good talkers would probably teach best in that way. To such teachers this book will undoubtedly furnish many valuable hints.

A Hand-book of Industrial Organic Chemistry. By SAMUEL P. SADTLER, Ph.D. Philadelphia, Lippincott. 8°. $5.

WAGNER'S "Chemical Technology," which is about the only book of moderate size in English which describes the chemistry of industrial processes, is now somewhat antiquated, though doubtless some day a new edition will appear. There are the encyclopedias of chemistry and of chemical industries, but no single volume.

Dr. Sadtler has endeavored, within the compass of a moderate-sized octavo, to take up a number of the more important chemical industries, or groups of related industries, and to show in language capable of being understood, even by those not specially trained in chemistry, the existing conditions of those industries. The present volume is limited to industrial organic chemistry. This field, while covering many very important lines of manufacture, does not seem at present to be so well provided for as the inorganic part of the subject. A companion volume, covering this other side of industrial chemistry, is in contemplation.

In taking up the several industries for survey, there are first enumerated and described the raw materials which serve as the basis of the industrial treatment; second, the processes of manufacture are given in outline and explained; third, the products, both intermediate and final, as well as side-products, are characterized and their composition illustrated in many cases by tables of analyses; fourth, the most important analytical tests and methods are given which seem to be of value either in the control of the processes of manufacture or in determining the purity of the product; and, fifth, the bibliography and statistics of each industry are given, so that an idea of the present development and relative importance of the industry may be had.

The author has endeavored in a number of cases to give a clearer picture of the lines of treatment for an industry by the introduction of schematic views of the several processes through which the raw material is carried until it is brought out as a finished product.

The subjects treated are: petroleum and mineral oil industry; industry of the fats and fatty oils; industry of the essential oils and resins; the cane-sugar industry; the industries of starch and its alteration products; fermentation industries; milk industries; vegetable textile fibres; textile fibres of animal origin; animal tissues and their products; industries based upon destructive distillation; the artificial coloring matters; natural dye-colors; bleaching, dyeing, and textile printing.

That such a book is needed cannot be questioned. It will be of value to the specialists engaged in industrial chemistry and to the general reader seeking information.

The author has had experience in writing chemical books and in editorial work. The number of illustrations is large, and they are well made and increase materially the value of the book for the purposes for which it is intended. There is also a considerable number of valuable tables.

A Study of Greek Philosophy. By ELLEN M. MITCHELL. Chicago, S. C. Griggs & Co. 12°. $1.25.

THE authoress of this book has been for some years the leader of a band of ladies who have devoted themselves to the study of philosophy. Being a disciple of Hegel, it was natural that she should devote special attention to the history of philosophy, that aspect of the subject having been given special prominence by Hegel himself and by some of his principal followers; and this sketch of the Greek philosophy is the outcome of her studies. It is written in an earnest and serious spirit, and with an evident desire to present the truth as the writer understands it. It is impartial, too, as between the different schools and thinkers, none of them being slighted and no decided preference shown for one over another except as their real importance demands it. The chief fault of the book, to our thinking, is its excessive Hegelianism. In treating the various Greek thinkers, those points in their teaching that seem to anticipate Hegel's philosophy, or lend it support, are given special prominence, and sometimes there is a tendency to read into the ancient writers views derived from Hegel himself. Then the frequent repetition of the Hegelian catchwords, such as "self-consciousness," "the idea," "subjectivity and objectivity," the "infinity of mind," etc., detracts from the merit of the work.

Miss Mitchell has followed Zeller largely in her interpretation of the Greek thinkers, but has also derived something from Hegel's history of philosophy, and she quotes occasionally from both these writers. Her account of the earlier philosophers is one of the best parts of her work, their leading characteristics, as far as known, being very clearly presented in a small space. In the chapters relating to Plato and Aristotle the dialectics and physics of these writers are examined at greater length than seems necessary; while in the latter part of the book we could have wished for a little more information about the relations between Greek philosophy and Jewish and Christian thought. But though the book is not free from faults, it has much to recommend it, and it will be specially acceptable to adherents of German philosophy.

The Philosophy of the Beautiful. I. Its History. By WILLIAM KNIGHT. New York, Scribner. 16°. $1.

THIS book is one of a series to be published by John Murray in England and by Messrs. Scribner in America, and designed to furnish books for study and reference on a variety of subjects. They bear the general title of "University Extension Manuals," and, if we may judge from the names of the books and authors given in the prospectus, are likely to be of real value. The volume before us is by the editor of the series, and is devoted to a history of esthetics from the days of the Greek philosophers to the present time. Another volume is projected by the author, in which he will discuss the subjects of beauty and art themselves, and will present a constructive theory of his own. The present work is a succinct but useful summary of the teachings of previous writers, presented with impartiality and in a clear and attractive style. The ancient writers are first treated of, Plato and Aristotle occupying the foremost places; and then, after a brief glance at certain mediæval philosophers, the esthetic writers of modern times are taken up, those of each nation being grouped together. Thus the philosophy of Germany from the earliest times to the present is first dealt with, then those of France, Italy, Holland, Britain, and America. This arrangement enables us to see the effect of national genius on the philosophy and criticism of art, but fails to show with equal clearness what the writers of one nation have owed to those of another. The principal fault of Professor Knight's work, as it seems to us, is the attention given to insignificant authors, who contributed nothing to the subject, either by philosophy or by criticism, and who might better have been passed over in silence. The impression produced on the mind by the book is in one respect discouraging, for it seems to show that little real advance in the philosophy of beauty has been made since ancient days. The theory, first promulgated by Plato and afterwards adopted by Aristotle, that the essence of beauty consists in harmony and proportion, still holds its ground; but the dispute between Aristotelian realism and Platonic idealism is as unsettled as ever. We commend Professor Knight's book to students of esthetics, and shall look with interest for his second volume.

Electricity and Magnetism. Translated from the French of AMEDEE GUILLEMIN. Revised and edited by Silvanus P. Thompson. London and New York, Macmillan. 8°. $8.

THIS is certainly as fine a piece of book making in the line of the physical sciences as we remember having seen for some time. A few French writers have in the past brought out these handsome volumes in popular exposition of this or that branch of science, and occasionally these have been translated. But there have been few published in English except as translations.

That Professor Silvanus P. Thompson is known as the writer of good books in electrical science goes without saying, and his standing as a physicist is unquestioned, as has been recognized by his election not many years ago as a Fellow of the Royal Society. The editor, however, claims responsibility on but a few points. The chapters on dynamo-electric machines and on the telephone were largely rewritten by him, and brought into accordance with modern knowledge; and throughout the book frequent editorial notes in brackets are inserted that bring the statements up to date.

The book is not intended for the student, but as a popular, simple, non-mathematical exposition of the science which now attracts such general interest. The volume is certainly one on which a great amount of labor and money must have been expended, but there has been left in a great deal of matter of purely historical interest, matter not of a character likely to please any one looking only for the latest information. Electrical science has moved considerably in the past ten years, and it has been difficult for the editor to conceal the evident influence of the Pan-Electrical Exposition of 1881 as a recent event on the French original.

When one is asked for a popular book on electricity and magnetism, the answer is a difficult one, since such valuable manuals as the "Principles of Electricity and Magnetism," by Professor Thompson, may prove too formally scientific for the untrained reader. There is certainly no other work in English that treats electricity and magnetism in so untechnical a way as does this by Guillemin; we only question whether it might not have been of half the size and served its purpose as well. The first part of the volume is devoted to the pure science, the second to the applications in the industries.

AMONG THE PUBLISHERS.

F. A. BROCKHAUS, Leipzig, announces a new edition (the fourteenth) of his "Brockhaus' Konversation-Lexikon." The first volume of the first edition was published in 1796, so that the present is projected as a sort of century-jubilee edition. The work will be very much enlarged and printed in a sumptuous manner. It may be had in 256 weekly parts or in sixteen bound volumes.

— Messrs. D. Appleton & Co. are about to publish "Freeland: A Social Anticipation," by Dr. Theodor Hertzka, a book which has been called the German "Looking Backward." This work describes an imaginary colony in equatorial Africa, in which Dr. Hertzka's economic system of land and capital nationalization, combined with absolutely untrammelled industrial competition, is carried out. The book has given rise already to local societies in Vienna, Buda Pest, Prague, Czerarowitz, Berlin, Hamburg, Brunswick, Hanover, and some fourteen other places, which will ultimately be united into an International Free Society for the purpose of establishing such a colony as is described in the book.

— *Babyhood* contains the following among other articles in its October issue: "The Management and Care of Near-Sighted Eyes," by J. M. Mills, M.D.; "The Airing and Exercise of Infants," by Alfred Stengel, M.D.; "The Bones in Childhood," by Harriet Brooke Smith, M.D.; "Nursery Ventilation;" "The Nursery Chair;" "Sweets;" "From One to Five;" "How to Carry the Baby;" "Neglect of Milk Crust;" "Fat Babies *vs.* Lean Babies;" "Blowing Baby's Nose;" "A Night Jacket:" "Washing Baby's Flannels;" "Contagion from Whooping Cough;" "Buying a Cow for the Baby;" "Condensed Milk for a Long Journey;" "Quantity of Food at One Year;" "Hard and Soft Water as Affecting Teeth;" "A Cure for the Green Apple Habit."

— "Seas and Lands" is the title Sir Edwin Arnold has given to the account of his recent travels, which the Longmans will publish at once. The earlier chapters are devoted to Canada and the United States, but the bulk of the book is given up to Japan as it impressed the author of the "Light of Asia" day by day. There are more than forty full page illustrations from photographs. The same firm will issue at once Canon Farrar's new copyright novel, "Darkness and Dawn; or, Scenes in the Days of Nero." This historic tale is the author's first venture into fiction for many years, and it is the result of his investigation into the early history of Christianity. He has stuck more closely to the facts than most writers of fiction, and he declares that the "outline of his story is determined by the actual events of pagan and Christian history."

— In the *Magazine of American History* for October an article by the editor, "A Group of Columbus Portraits," deals with facts and picture-pedigrees, giving fac-similes of the oldest and rarest engraved prints of Columbus portraiture extant, with much other data of timely consequence. The double-headed contemporary print of the portraits of Ferdinand and Isabella is included; and Mrs. Lamb adds to her essay suggestive sketches of those sovereigns and their great military triumphs in connection with Columbus and the dawn of America upon the map of the world. W. F. Ganong follows with a paper on "The St. Croix of the Northeastern Boundary," and four illustrative maps. "Hugh McCulloch on Daniel Webster" is an excerpt of interest. The longest article in the number is a study by Right Reverend M. F. Howley, D.D., P.A., of Newfoundland, on "Cabot's Landfall," the scene of which he traces, according to his judgment, in an elaborate accompanying map. Then comes a contribution pertinent to the approaching World's Fair, "The Sultan of Turkey and the Chicago Exhibition," by Frederick Diodati Thompson, touching on the calamities and historic growth of Chicago, and presenting many facts about Turkey and its ruler, whose visit to America on the opening of the Columbian exposition is foreshadowed. Other articles include "Philadelphia in 1778 through Foreign Eyes," and "Napoleon Bonaparte and Peace with America."

— Dr. De Kroustckoff, an eminent chemist and mineralogist of St. Petersburg, recently paid a visit of some weeks to the United States, charged with a scientific mission by the Russian Government. Dr. de Kroustckoff announces a series of translations in Russian from the works of leading American, French, and German scientists. The first of these volumes, it is expected, will appear next year, and is to comprise the greater part of Dr. T. Sterry Hunt's "New Basis for Chemistry," together with his studies of the origin and succession of crystalline rocks, the crenitic hypothesis, and various related subjects.

— Messrs. Macmillan & Co. will publish next month a "Browning Cyclopædia," by Dr. Edward Berdoe, one of the most active members of the Browning Society. This volume will deal with the whole of the poet's works, and will contain a commentary on every poem, with explanations of all obscurities and difficulties arising from the historical allusions, legends, classical and archaic phraseology, and curious out-of-the-way terminology, which makes Browning so difficult for the ordinary reader.

— Professor J. R. Cooke of Harvard University, author of the well-known "New Chemistry" in the International Scientific Series, has written a most helpful new book entitled "Laboratory Practice," which, as its name indicates, will be a practical aid to students. The book is designed for a companion to Professor Cooke's "The New Chemistry," which has been for many years a standard work, and has been translated into all the principal European languages. The new book is brought out by the publishers of the other, D. Appleton & Co.

— In addition to the fall announcements of Macmillan & Co., made in our issue of Sept. 25, we note the following. "Symbolism in Christian Art," and "Heraldry," by F. E. Hulme; "Monumental Brasses," by the Rev. H. W. Macklin; Behaghel's "The German Language," translated and adapted for the use of English schools by Emil Trechmann; "A History of Early English Literature," by the Rev. Stopford A. Brooke; "The Buccaneers of America," by Captain James Burney (reprinted from the edition of 1816); "Some Aspects of the Greek Genius," by S. H. Butcher, professor of Greek, Edinburgh; "The Inferno of Dante," translated, with a commentary, by A. J. Butler; "English Literature at the Universities," by S. Churton Collins; "Browning's Message to His Time," by Dr. Edward Berdoe (with a portrait and facsimile letters; second edition, revised and enlarged); "Dante and His Ideal," by Herbert Baynes (with a portrait); "Goethe," by Oscar Browning (with a portrait); "Dante," by Oscar Browning (with portrait); "Browning's Criticism of Life," by W. F. Revell; "Henrik Ibsen," by the Rev. Philip H. Wicksteed; "Epictetus (the Discourses of)," with the Eucheiridion and Fragments reprinted from the translation of George Long (printed on hand-made paper, bound in buckram); "Battles, Bivouacs and Barracks," by Archibald Forbes; two new volumes of essays by E. A. Freeman (I. — Historical, II. — Miscellaneous); "A Short Manual of Philology for Classical Students," by P. Giles, fellow of Gonville and Caius College, Cambridge (uniform with Dr. Gow's "Com-

Publications received at Editor's Office, Oct. 7-13.

BRAINARD, F. R. The Sextant and other Reflecting Mathematical Instruments. New York, Van Nostrand. 120 p. 16°. 50 cents.
CANADA, Annual Report of the Geological and Natural History Survey of, 1888-89. Vol. IV. Montreal, Government. 4°. $2.
COOKE, J. P. Laboratory Practice. New York, Appleton. 192 p. 12°. $1.
GUILLEMIN, A. Electricity and Magnetism (rev. and ed. by S. P. Thompson). London and New York, Macmillan. 976 p. 4°. $8.
KNIGHT, W. The Philosophy of the Beautiful. New York, Scribner. 288 p. 12°. $1.
MITCHELL, E. A Study of Greek Philosophy. Chicago, Griggs. 282 p. 12°. $1.25.
PLYMPTON, G. W. How to Become an Engineer. New York, Van Nostrand. 218 p. 16°. 50 cents.
STODDARD, C. A. Across Russia. New York, Scribner. 258 p. 8°. $1.50.
UNITED STATES and the Dominion of Canada, Normal Temperature Charts by Decades for the. Washington, Government. 72 p. f°.

panion to School Classics"); "The Present State of the Fine Arts in France," by P. G. Hamerton; "The New Calendar of Great Men," edited by Frederic Harrison, author of "The Choice of Books;" "Text-Book of the Developmental History of the Vertebrates," by Dr. Oxar Hertwig, professor of comparative anatomy in the University of Berlin (translated and edited by Dr. E. L. Mark of Harvard); "Story of the Hills," by H. M. Hutchinson, author of "The Autobiography of the Earth;" "The Government of Victoria" (Australia), by Edward Jenks, professor of law in the University of Melbourne; "Text-Book of the Developmental History of the Invertebrates," by Drs. Korscheldt and Heider of Berlin (translated under the supervision of Dr. E. L. Mark of Harvard); "Historical Outlines of English Syntax," by the Rev. R. Morris and Dr. L. Kellner; "Religious Systems of the World: Pre-Christian, Christian and Philosophic," a series of essays by eminent specialists (second edition, revised and considerably enlarged, containing more than twenty additional articles); "British Seas," by W. Clark Russell (with numerous illustrations); "The Wisdom of Life," "Counsels and Maxims," "Religion," "The Art of Literature," and "Studies in Pessimism," by Schopenhauer (new edition, translated by T. Bailey Saunders); "Commercial German," by F. C. Smith; "Fossil Botany," an introduction to paleophytology from the standpoint of the botanist, by H. Graf zu Solms-Laubach, professor in the University of Göttingen (authorized English translation by Henry E. F. Garnsey, fellow of Magdalen College, Oxford; revised by Isaac Bayley Balfour, professor of botany in the university and keeper of the Royal Botanical Garden, Edinburgh); "England and the English in the Eighteenth Century: Chapters in the Social History of the Times," by William Connor Sydney; "Diphtheria: Its Natural History and Prevention," by Dr. Thorne Thorne; "Madhiism and the Soudan" (an account of the rise and progress of Madhiism, and of the subsequent events in the Soudan to the present time) by Major F. R. Wingate, R.A.

SCIENCE

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SCIENCE

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GOVERNMENTAL SCIENCE AND THE CIVIL SERVICE.

THE visitor to Washington who has been acquainted with its life and appearance in the past notices many striking changes for the better that have taken place within the last ten years. Perhaps none of these make more lasting impressions on him than those which are brought about by the great alterations affecting the official life of the city, which are due to what are generically termed civil service reforms. The dweller in a Washington boarding-house or small hotel — and these are *sui generis* in the *personnel* of their inhabitants — sees far less of the feverish uncertainty, constant fear of the departmental headsman, and hesitancy in claiming the possession of one's own soul, than was to be observed a decade ago. To the civil service acts passed by Congress since 1882, the promptness in putting their requirements into force shown by Presidents Cleveland and Harrison, and the efficiency of the commissioners having this branch of the public service in special charge, is to be attributed the present condition of this reform — for reform it undoubtedly is.

In their report for 1889 the commissioners say, "The merit system of making appointments to minor government positions, as contrasted with the patronage system, whereby appointments were made as rewards of personal or political services, is no longer in the merely experimental stage." What was true in 1889 must be doubly so in 1891. It is but fair, then, to point out wherein certain customs and rulings of the commissioners are still unjust to the entire people, and have a pernicious effect on important branches of the public service. The nature of these defects can best be pointed out after quoting further from the report of the commissioners. They say: "Examinations are held for scores of different places; and for each place appropriate tests are provided. Thus it is necessary for an assistant chemist to know something of chemistry, and for an assistant astronomer to know something of astronomy. . . . There is an impression abroad that those who take examinations at Washington have some advantage over those who take them elsewhere. There seem to be some good grounds for it with regard to the special examinations. This is probably due to the fact that very many of those who are examined here have better opportunities than those living elsewhere for acquiring a knowledge of those technical subjects which are required by the different departments."

As an illustration of how this may work, let me cite the following case. A few weeks ago a position was vacated in one of the divisions of the Agricultural Department, and announcement of the fact that an examination would soon be held for such a vacancy, requiring "a person understanding botany, Latin, and Greek," was made in the daily press of the city. This announcement, according to the custom of many local papers throughout the Union, found its way into the home of a trained botanist and linguist in one of our southern States. This he mailed at once to a friend with the request that he would ascertain for him when, where, and how the proposed examination was to be held. Imagine this friend's surprise when, on application for this information at the office of the Civil Service Commission, he was informed that the position was already filled, the examination having been held two days before. Yet his correspondent, who lived less than a thousand miles from Washington, had written him at once on receipt of the announcement, and the local weekly paper could not have sooner inserted the information found in the dailies. Further conversation with the officer to whom he was referred at the office of the commission, and inquiry at the Department of Agriculture, elicited the following facts. If a vacancy is to be filled, the Civil Service Commission gives ten days notice of the special examination therefor. If a person living outside of Washington wants to be examined for the vacancy he must write to the commissioners, preferring his request, and a special examination will be held for him at some place designated by them, the capital of the State usually being the place selected. In this particular case the vacancy was undoubtedly creditably filled; though the appointment of the southern resident, who only heard of the vacancy the day that it was filled, would have shed far more lustre on the department, as he outranked in scholarly and scientific attainments most of those with whom he would have thus been brought in contact.

In the ordinary offices, such as those of clerks, copyists, stenographers, pension examiners, railway-mail clerks, letter carriers, etc., the applicants far outnumber the needs of those respective branches of the service, as is shown by the fact that, while in 1887 the entire number of offices under the custody of the commission was 28,000, they were called upon to examine over 20,000 applicants for the vacancies in those ranks. So it is the fact that in these grades the existing rules act admirably and tend to the continual elevation of the public service. But in such positions as those of examiners of the Patent Office, and technical and scientific experts in the various departments, the present system is very imperfect, inasmuch as it is hardly possible that any considerable portion of the scientific and technical skill of the country is in Washington seeking a position. Surely a very respectable majority of such talent must be in cities far removed from the national capital, and any system which practically rules out all the regions not within a few hours' ride of Washington is abortive, and degrading of the general standing of scientific officialdom.

If such positions as have been indicated are to be filled under the laws governing the Civil Service Commission, then the commissioners should at once put into force rules that would do away with this very evident local favoritism, and which would enable the practical geologist in southern California to compete on fair terms with the recently graduated youths from the Columbian and Johns Hopkins Universities. It is quite as practicable that printed announcements of such vacancies should be posted in every post office in the country as it is that they should receive the daily weather bulletins. And no examination should be held until the resident of the most remote corner of the West had had ample time to apply to the commission for a special examination in his locality, and such a local special examination should never be held in a more remote place than the county-seat of the county where the person to be examined resides. There can be no reason why the paper containing the examination questions may not be safely mailed to the postmaster, the seals not to be broken save in the presence of all of a board of three, to consist of the postmaster, a prominent professional man of the town, and a notary public. Before these the applicant could appear, and in their presence answer the questions sent to them. To the facts of the regularity of the examination they could swear, returning the affidavits and the applicant's answers to the commission. As these special examinations are infrequent, and the positions for which they are held are of considerable importance, and should be filled by the best men at the disposal of the government, no plea of extra expense, of unnecessary trouble, nor of danger of collusion should be heeded. The latter danger would be practically *nil;* it is inconceivable that three prominent men, not more than two of whom should be of the same political party, would jeopardize their positions and reputations in their communities by any form of collusion. If these positions are not worthy of this small extra outlay of time, patience, and cash by the commission, they are confessedly not worth filling at all. The present plan contributes to a degree of departmental degeneracy and the continued existence of certain hangers-on, the relics of the departing age of political preferment, which should no longer be tolerated. At present it is quite as likely to be the ne'er-do-well friend of some clerk in the bureau where the vacancy is about to occur, who, getting an early hint of the coming vacancy, rushes to one of the schools where cramming for these examinations is given special attention, as it is to be a trained expert from New England, the South, or the West.

These suggestions have been based on the supposition that the present laws selecting the offices that shall be open to the control of the commission will remain substantially as at present. The outsider, who feels only an interest in the improvement of official science as it is to be met in the capital, will be quite likely to agree with me that at present the examination regulations are attached to the wrong end of the machine. It is the heads of bureaus, and not the more obscure officials, whose offices should depend on these examinations. What matters it whether the stenographer of a bureau be an expert in his profession if the chief whom he is under dictates to him letters which plainly attest the fact that he is holding his position by virtue of political favoritism and has not yet become acquainted with the intricacies or the science of his office? So long as the head of a scientific division of a department may be chosen without reference to his eminent fitness for the discharge of his duties, it is but a pitiable farce that leads to such care being taken to provide him with competent men to transact work which he cannot direct and of which he is not a judge. If the chiefs were chosen after a searching examination into their position among their fellows in the science, the knowledge of which they were called upon to display, it might be found then that the government had thereby obtained the services of a class of men who could be trusted to choose their own underlings. I believe that this can be now said of most of these heads of divisions and bureaus, yet one is compelled to admit at times the justice of the slurs at the work done under these that the American must be prepared to hear from the lips of foreigners. There is undoubtedly yet a taint of cheapness and unworthy show about much of this work, for which the half-pay salaries allowed by Congress and the imperfect system of examination now in vogue, as here indicated, are mainly responsible. EUGENE MURRAY AARON.

INDICATIONS OF EVOLUTION IN LEAVES.

As evolution is the eternal plan of unfolding, in the past, from nebulous matter to plant and animal life, it is absurd to suppose the same principle of progression will not continue to produce changes in the whole realm of being in all time to come.

The investigator puts his finger on the long past geologic ages and says, "These forms are all that existed at this time:" then he points out the advance of later times, and says, "This is evolution." But how this almost infinite change has been brought about, even the imagination constructs no definite plan. It is only by studying the evolution of the present that we can appreciate the changes of the past. To say that things are unchangeable is to ignore the truths of evolution. There is an ever on flowing, rising tide which bears all things on its bosom, unfolding higher conditions, and, as a result, more perfect forms and qualities.

The leaves of plants offer to the evolutionist perhaps one of the best opportunities for studying the principle of progression actually at work; producing changes in the forms of leaves, their mode of individualization, and numerical increase.

My attention was first attracted to the interesting study of variation in leaves by the Ampelopsis quinquefolia. As its name implies, it has five leaflets. Close observation, however, discerned leaves bearing seven leaflets. Sometimes the two lower leaflets were more or less notched or deeply lobed; continued search revealed various degrees of variation, from three to seven leaflets. These specimens were considered "abnormal," "freaks of nature," or "monstrosities,"—interesting because unusual. I soon observed that the Ampelopsis was not alone in its manifest variation from typical forms. On the contrary, plants quite commonly exhibit the same tendency. Rubus villosus is especially conspicuous in this respect. It has commonly from three to five leaflets, but very often the trifoliate leaves are notched and lobed as in the Ampelopsis.

Could it be that these different forms, these variations from the common type, were evidences of evolution in leaves? Can a series of leaves be found illustrating successive stages of variation, was the query which arose in my mind. The leaves of Ampelopsis quinquefolia were again examined, in all the neighboring region. They had given rise to the query, and should therefore have the first opportunity of rendering a verdict. As the search continued, these odd forms, these "monstrosities," seemed to arrange themselves in regular order, like crystals marching into line. Instead of being "freaks of nature," they now stood like many ballots in favor of evolution

Starting with the ordinary leaf of Ampelopsis quinquefolia, numbering five leaves, the progressive stages, until it numbers seven, were found repeatedly, perhaps a hundred specimens, from a single vine of luxuriant growth.

The first transition step apparently seemed to be but a slight enlargement or fulness on the lower or outer portion of the leaflets near the base; this fulness increases until quite a conspicuous bulge is formed. A slight notch may be next observed, which deepens as the series progresses until the lobe is cut entirely from the leaflet, becoming itself a new, perfectly formed leaflet. A prominent vein is found extending from the base of the mid-rib, through the overgrown or enlarged portion, to the extreme margin. This vein, later on in the series, forms the mid-rib of the added leaflet. The variation in the blackberry leaves emphasizes this interpretation. The trifoliate leaves seem to be struggling towards the higher type represented by the five leaflets. This is seen so plainly and so commonly that it is the exception when a blackberry bush is found whose leaves do not illustrate various transition stages of division.

Potentilla Canadensis, common cinque-foil or five-finger, furnishes an extremely interesting illustration of various transition forms. It is an embryonic history of evolution in itself, which any one may read who observes it closely.

Examples might be multiplied *ad libitum*, for plants everywhere, both in cultivation and wild, repeat the same story over and over again.

The mode of division in pinnate leaves differs from that just described in palmate leaves. In all pinnate leaves which have been observed, with one exception, the newly formed leaflets were given off from the terminal leaflet. The latter will often be found unsymmetrical or lopsided, occasioned by the extra fulness produced by this evolutionary tendency towards division. The vein which is destined to become the mid rib of the future leaflet becomes prominent, and the outline of the unborn leaflet, as it were, may be plainly seen ere the division has proceeded beyond a slight notch.

After a new leaflet has been given off, there seems to have been a portion of the parent leaflet cut away; and if the new leaflet be held close against this curved or cut portion, it will be found that it corresponds with the outline of the new leaflet. The opposite side of the parent leaflet will now be found to be the larger, and the burden of adding the next leaflet lies with it: after a leaflet has been given off from each side the terminal leaflet may again become symmetrical until a repetition of the process first described again takes place. Tecoma radicans, Sambucus Canadensis, Ailanthus, are familiar examples of this plan of division.

The development of bi-pinnate and tri-pinnate from the simple pinnate leaves was also observed frequently; especially was this noted in the leaves of Sambucus Canadensis. In this case the new leaflets are given off from the oldest leaflet, or that nearest the base, first on one side, then on the other, preserving the symmetry with such precision that one is awed by the beauty and harmony resulting from the workings of vegetative forces.

As stated above, there proved to be one exception to the general plan of division among pinnate leaves. This exception was found in the leaves of the rose. Search for transition stages was made again and again in vain, when one day, while examining the leaves, more from force of habit than with the hope of finding anything bearing on the subject of variation, the mystery was cleared away.

At the base of the rose leaf two adnate stipules are found, and these stipules themselves may be called the little mother-leaves, for the leaflets of the rose appear to have been developed from the stipules. Specimens were found where the "promise and potency" of the future leaf yet existed in the stipules, awaiting, as it were, the magic touch of evolution. The upper part of the stipule becomes enlarged and leaflike, taking on more and more the shape and size of the normal leaflet, until a perfect one is formed. A graduated and progressive series was frequently found, showing various stages of transition, from the stipules alone to the mature leaf, consisting of seven or more leaflets. The new leaflets may be readily discerned before they are given off or separated from the stipules.

The petiole lengthens as the leaflets are added, thus making room for the newcomers. If a rose-leaf is examined, the leaflets near the base will sometimes be found to be more or less alternate, but becoming opposite in the direction of the apex. This may be explained by the manner in which the leaflets are developed, viz., alternately.

The tendency in leaves to divide is manifested by many simple leaves. Very often on plants bearing lobed leaves, deeply lobed or cleft ones are found; and again, on those plants where entire leaves obtain, more or less notched or lobed ones often occur.

An increased leaf-surface implies a larger amount of elaborated plant food, and consequently an increased product, either in rapidity of growth, beauty of bloom, quantity or quality of fruit. Spencer says, "Every change of form implies change of structure; and with change of form and structure comes change of function or quality." The same laws of development are seen in the study of leaves as in the social world. Heredity gives the direction in the bud or germ, and the conditions or education unfolds it. If the season is favorable, the leaf takes a pre-impressed direction of growth, and surpasses its neighbors in assuming new forms, and the average is passed; while unfavorable conditions may produce a degradation, or appeal only to the lower states of development. It will be understood, therefore, that I do not mean to convey the idea that leaves undergo this evolutionary division during a single season. On the contrary, the principles of "natural selection" and "the survival of the fittest" have left their impress upon the animal and vegetable kingdom alike. Slowly but surely heredity transmits the gain through good conditions to succeeding generations. Through the long ages of the past this process has been going on; each generation has passed on the improvements it received from its ancestry, and has added its own gain for the advance of its posterity. Each generation comes forth with renewed powers to unfold in some special direction, and I have endeavored to show, in a few cases, the plan followed in the evolution of leaves.

MRS. W. A. KELLERMAN.

NOTES AND NEWS.

THE ninth congress of the American Ornithologists' Union will convene in New York City on Tuesday, Nov. 17, 1891, at 11 A.M. The meetings will be held at the American Museum of Natural History, Central Park (77th Street and 8th Avenue). The presentation of ornithological papers will form a prominent feature of the meetings, and members are earnestly requested to contribute, and to notify the secretary in advance as to the titles of their communications, so that a programme for each day may be prepared.

— Mr. Michael E. Sadler, the secretary of the Oxford University Extension, has accepted the invitation of the American Society for the Extension of University Teaching to lecture under its auspices in December and January of the coming winter.

— Mr. Halford J. Mackinder, reader in geography to the University of Oxford, and staff lecturer to the Oxford University Extension, comes to Philadelphia next March to lecture under the auspices of the American Society for the Extension of University Teaching, 1602 Chestnut Street, Philadelphia.

— The American Society for the Extension of University Teaching proposes to hold, during the holidays, a conference of the leading college men of the country, to consider the subject of university extension from a college point of view. This conference ought to result in broader views of the relation of the university to university extension.

— University extension has attracted much attention in France. The ministry of education has appointed a committee to investigate the workings of the movement in England, and delegates of the French government were present at the Oxford summer meeting.

— Rev. W. Hudson Shaw, M.A., one of the most popular of the Oxford university extension lecturers, has been engaged by the American Society for the extension of University Teaching for the entire winter of 1892–3.

— The effort of the American Society for the Extension of University Teaching to establish the system of graded work in the Philadelphia centres is meeting with strong success. The West Philadelphia centre has agreed to follow courses of twenty-four weeks each, in literature, history, and science. Wagner Institute plans two such courses in literature and American history. In urging this graded work upon the centres, the popular idea is not lost sight of, but is united with that of consecutive, well-graded study.

— The University of Wisconsin offers for the coming winter university extension lectures on "The Colonization of North America," by Professor Turner; "English Literature," by Professor Freeman; "Scandinavian Literature," by Professor Olsen; "Antiquities of India and Iran," by Dr. Tolman; "Bacteriology," by Professor Birge; "The Physiology of Plants," by Professor Barnes; "Electricity," by Dr. Loomis; and "Geology," by Professor Salisbury. Courses in other departments will be given if any desire for them is expressed. According to the regulations adopted by the board of regents, courses can be given only where the lecturers can go and return without interfering with their class-room duties; but if the success of the proposed courses warrants it, lecturers who can give their entire time to the work will probably be provided.

— Cincinnati has begun the work of university extension with great enthusiasm and zeal. Classes in history, chemistry, and Latin have already begun. Biology, analytics, and trigonometry are proposed for a later course.

— Rhode Island is a conservative state, but when it makes up its mind to change, it enters upon the proposed work with earnestness and vigor. Brown University has already successfully inaugurated university extension in the State. The promptness with which the various towns follow its lead is only a new example of the power which the universities possess for developing and moulding the educational interests of the State. Mount Pleasant, one of the suburbs of Providence, has just formed a new extension centre, with lectures on English history, by President Andrews of Brown University. Professor Wilfred H. Munro, director of university extension for Brown University, has been invited to explain the movement and help in the organization of a centre at Newport. The teachers of Providence are also interested, and plans for several classes under university professors are being discussed.

— The Trenton, N.J., university extension centre offers four courses of six lectures each, in place of the single course given last year. This indicates strong and healthy growth. The first course will be from Oct. 16 to Nov. 10, upon "The Plays of Shakespeare," by Dr. Murray, dean of Princeton College; the second, "Historical Geology," from Nov. 17 to Dec. 22, by Professor W. B. Scott of Princeton; the third, "Political Economy," from Jan, 12 to Feb. 16, by Professor Robert Ellis Thompson of the University of Pennsylvania; and the fourth, illustrated lectures on "Light and Color," from Feb 23 to March 29, by Professor Goodspeed of the University of Pennsylvania. Besides furnishing these twenty-four lectures for three dollars, the Trenton centre offers a supplementary course without charge, if, as is quite probable, the funds received warrant it.

— Topeka, Kan., is to have a university extension course of twelve lectures on electricity, by Professor Blake of the University of Kansas.

— Kansas City has organized a society of university extension, with Hon. Edward H. Allen, president; Professor John T. Buchannan, vice-president; J. F. Downing, treasurer; and John Sullivan, secretary. At the meeting when the organization was effected, short addresses were made by Professor Blackmar of Kansas University, and by Dr. S. S. Lows of Kansas City, ex-president of Missouri University. Professor Blackmar stated that Kansas University would offer eighteen different courses to the people of Kansas City.

— Among the encouraging signs of the times we observe that the colleges open with full classes, and, usually, large accessions. Harvard, Yale, and the Massachusetts Institute of Technology, in New England, the University of Michigan, and all the State universities of the West, as well as Columbia, Princeton, and Lehigh, nearer our own doors, all report crowded classes. Our own State university — Cornell — is just heard from, the accounts of the registration having only just been made up, owing to the rush of business in the registrar's office. The Ithaca *Journal* gives us the following for Oct. 15: freshmen, 431; sophomores, 327; juniors, 221; seniors, 186; graduate students, 126; total, 1,491. The *Journal* of the 17th states that accessions for the week carry the total above 1,500; while the increase for the year, dating back to Oct. 15, 1890, is about 225, or 15 per cent. The increase, curiously enough, is mainly in the two extremes, arts and engineering; the other courses remaining about stationary. Candidates for B A. number 140, for C.E. and M.E. about 650. The university is about equally divided between the literary, the so-called liberal, departments and courses, and the scientific and engineering. Sibley College enrolls just one-third of the students in the university, having 481 undergraduates, of whom 193 are regular freshmen; while its proportion of the graduate students and its "specials," of whom we are told there are usually about a dozen, makes its enrolment somewhere about 525 in all. The number of graduates, principally coming from other colleges, has trebled in the year. The university is greatly embarrassed, notwithstanding its great endowment, by the continual demands for new buildings, which must be paid for out of the income.

— In a recent number of *Petermann's Mitteilungen* Dr. F. Krümmel states the results of his investigations of the Sargasso Sea, a summary of which is given in the Proceedings of the Royal Geographical Society for October. He differs entirely from Humboldt as to the shape of the floating mass of vegetation. The "great bank of Flores and Corvo" is, he says, Humboldt's summing up of the observations made by sailing-vessels passing through the Sargasso Sea on their way from the southern hemispere to Europe. These followed with slight variations the same course, and their observations were naturally limited in extent. It was on these insufficient data that Humboldt founded his theories as to the size and shape of the Sargasso Sea, but now, by the aid of steam, we are able to arrive at more correct conclusions on these points. On a map which he has prepared, Dr. Krümmel has plotted out the general contour of the mass of floating vegetation, and has indicated in what parts of the sea the sargasso is found in the greatest abundance. In shape the Sargasso Sea is a sort of ellipse, the great axis of which almost coincides with the Tropic of Cancer, while the two foci are near longitude 45° and 70° west. Around this central ellipse others are indicated, larger in size, but with the vegetation much less dense. In their general outlines they follow with sufficient nearness the course of the prevailing winds. As to the origin of the algæ, Dr. Krümmel is strongly of the opinion that they come from the land — not only from the Gulf of Mexico and the coast of Florida, but from the shores of the Antilles and the Bahamas. The most recent studies with regard to the origin and course of the Gulf Stream tend, he thinks, strongly to support those who assert that the algæ come from the land, and to disprove the contention of those who support the hypothesis of a marine origin. Now that it is settled that the Gulf Stream is not a single narrow stream issuing from the Gulf of Mexico, but an accumulation of converging currents sweeping past the coasts of the Antilles and through the adjoining seas, it is obvious that the quantity of algæ carried away must be much greater than it could have been were the old hypotheses of the origin of the Gulf Stream correct. Dr. Krümmel makes an approximate calculation as to the time occupied by the algæ in reaching the Sargasso Sea. A fortnight after reaching the Gulf proper, the weed would, at the rate of two knots an hour, reach the latitude of Cape Hatteras. From that point its onward motion is slower, and it takes about five months and a half for it to reach west of the Azores. After reaching the Sargasso Sea the weed continues to move slowly, until, becoming heavier as it grows older, it gradually sinks to make way for fresh supplies.

— There will be an examination at the Civil Service Commission on Nov. 3 to secure two computers for the Nautical Almanac Office. The salary of one will be $1,000 and the salary of the other will be from $1.000 to $1,400, to be determined after examination. The subjects will be algebra, geometry, trigonometry, logarithms, and astronomy. Application blanks can be obtained of the commission. District applicants will not be admitted. Arrangements may possibly be made for examining applicants at prominent cities outside of Washington if applications are filed in time.

— Mr. J. C. Russell, who has been engaged in exploring the Mount St. Elias region of Alaska, has been heard from at Yakutat. He was not successful in reaching the top of the mountain, but he attained a greater elevation than the height of the mountain as reported by him last year, between 14,000 and 15,000 feet, and there were still some four thousand feet to climb to reach the summit. This places the height of the peak between 18,000 and 19,000 feet, and restores St. Elias to its former position of one of the highest mountains on the continent. La Perouse, in 1876, placed its elevation at 12,672 feet, and it has varied from this all the way to 19,500 feet, as given by Dall in 1874.

— The long talked-of expedition from Australia to the south polar lands has now assumed the title of a "Swedish-Australasian Expedition," and is likely soon to be equipped and dispatched. At a meeting held in Melbourne on the 3d of July last, according to the October Proceedings of the Royal Geographical Society, the report of the Antarctic Exploration Committee was read, in which it was stated that a grant of £1,000 had been proposed by the Queensland government, another of £1,366 on condition that the public subscribed £634, by the New South Wales government, and a third of £300 by the government of Tasmania. It remained to be seen what sum the ministry of Victoria would place upon the estimates. Added to the Swedish donation of £5,000, and a similar sum from Sir Thomas Elder, there remained a balance of £2,000 only to be subscribed and insure the success of the expedition, for the successful carrying out of which Baron Nordenskiöld had stated that £15,000 would be sufficient. At the recent International Congress at Berne a resolution of approval of the proposed expedition and hearty wishes for its success was passed on the reading of a paper on the subject by Admiral Sir Erasmus Ommanney. As a pioneer expedition the project is likely to accomplish most useful work, and its promotion, in face of many obstacles, is highly honorable to the public spirit of the Australian colonies.

— I once heard of a boy who had a pet seal given to him when it was quite young, says a writer in the *Illustrated American*. It became very tame, and used to cuddle up beside the dogs to sleep in front of the fire, and learned to perform very many tricks. One winter the storms were very severe, and the fishermen were at times quite unable to venture to sea to set their nets. As a matter of course fish were scarce, and the seal's food having been of fish alone, milk had to be substituted; but it consumed such vast quantities of the latter that, for purposes of economy, after a family council, it was decided to dispose of the beloved pet as soon as possible. The boy and a clergyman friend, who had always taken a lively interest in the pet, started off in a boat with their precious victim, and, when far enough out for safety, threw the seal into the water. Little did they expect the result, for the creature, feeling itself very much abused, rushed after the boat with all its might and main, uttering such tearful and heart-rending cries of grief that it was at last taken back into the boat, where it lay exhausted, sobbing and wailing like a child. When the familiar home was reached it soon regained its former gaiety and health, and lived to a good old age, little the worse for its adventure.

According to *Nature*, Mr. W. H. Harris of Ealing, England, records in *Nature Notes* (Sept. 15) a remarkable instance of "frugality" in bees. The recent extremely rainy weather seems to have suggested to his bees that there would probably soon be an end of honey-making. Accordingly, although there was "a crate of fairly filled sections above the stock-box," they adopted vigorous measures to prevent future inconvenience. "It is a positive fact," says Mr. Harris, "that my bees, not content with ejecting larvæ of both drones and workers, proceeded to suck out the soft contents of the corpses, leaving only the white chitinous covering, which had not hardened sufficiently to prevent the workers from piercing it with their mandibles, and then inserting their tongues."

— Mr. W. Prentis of Rainham, England, describes in the October number of the *Zoologist* an interesting case of a wild duck's forethought. As quoted in *Nature*, a mowing machine was set to work round the outside of a field of lucerne bordering a marsh, diminishing the circle each time round the field, leaving about two acres in the centre. A wild duck was seen by the shepherd to fly from the piece of lucerne that was left with something in her beak, and, happening to fly near him, she dropped a three-parts incubated egg. She was again observed by the shepherd, and also by the sheep-shearer, carrying another egg in her beak, this time over the marsh-wall towards the saltings; and again she was seen for the third time carrying an egg in her beak in the same direction. Next day, when the field was finished by the removal of the last piece of lucerne, the wild duck's nest from which the eggs had been removed was discovered.

— Carl Lumholtz (author of "Among Cannibals"), who is the head of the expedition now making explorations in the Sierra Madre of Mexico, under the auspices of the American Geographical Society and the Museum of Natural History of New York, will write exclusively for *Scribner's Magazine* the results of his investigations and adventures. The first paper will appear in the November issue. Dr. Lumholtz says: "My intention is to investigate accurately the language, habits, and customs of the primitive people of the Sierra Madre by living with them, as I did with the natives of Australia; and thus I may hope to do my share in the noble work of elucidating the history of the native race of this great continent."

— The Imperial Academy of Sciences, Vienna, has just published in its Memoirs (Vol. XXXIX., Part First) a posthumous work of the traveller Dr. J J. von Tschudi, which is of uncommon interest to ethnographers and linguists. Its title is "Culturhistorische und sprachliche Beiträge zur Kenntniss des alten Perú" (Wien, F. Tempsky, 1881, pp. 220. 4°). The contents are arranged under thirty eight headings having Indian names, and to give an idea of these, some of those more generally known may be mentioned here: Amaúta, Apatchita, Ketchua, Korikantsa, Llama, Papa, Pariana, Patchakamak, Sairi, Tawantin-suyu, Waka, Waskar (usually spelled *huaca, huaskar*), Wirakotcha. In the article "Ketchua" he gives his reasons for defending Clements Markham's opinion, that there had never been an Aimará people, but that the language called Aimará was really that of the Kola'o, or, as we will call them now, Collas. This people was of a sturdy, ferocious race of mountaineers, which resisted for many years the attempts at subjugation made by the Inca "kings." When they had been conquered, the kings colonized other provinces with Kola'o men, who were forced to emigrate, and placed colonists in the Kola'o country, who were taken from Ketchua-speaking populations of the province Aimará. Thus a mixed people was formed, and a new medley language originated among it, which we know under the name of Aimará. In this medley language the elements of the Kola'o are still recognizable from those of the intrusive Ketchua, and prove to be of another linguistic family. Markham's idea of its origin has been also upheld and further developed by Tschudi in his excellent book "Organismus der Ketchua-Sprache" (1884).

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CELESTIAL PHYSICS.[1]

(Continued from p. 215.)

THE spectra of the stars are almost infinitely diversified, yet they can be arranged, with some exceptions, in a series in which the adjacent spectra, especially in the photographic region, are scarcely distinguishable, passing from the bluish-white stars like Sirius, through stars more or less solar in character, to stars with banded spectra, which divide themselves into two apparently independent groups, according as the stronger edge of the bands is towards the red or the blue. In such an arrangement the sun's place is towards the middle of the series.

At present a difference of opinion exists as to the direction in the series in which evolution is proceeding, whether by further condensation white stars pass into the orange and red stages, or whether these more colored stars are younger and will become white by increasing age. The latter view was suggested by Johnstone Stoney in 1867.

About ten years ago Ritter, in a series of papers, discussed the behavior of gaseous masses during condensation, and the probable resulting constitution of the heavenly bodies. According to him, a star passes through the orange and red stages twice; first during a comparatively short period of increasing temperature, which culminates in the white stage, and a second time during a more prolonged stage of gradual cooling. He suggested that the two groups of banded stars may correspond to these different periods, the young stars being those in which the stronger edge of the dark band is towards the blue, the other banded stars, which are relatively less luminous and few in number, being those which are approaching extinction through age.

Recently a similar evolutional order has been suggested, which is based upon the hypothesis that the nebulæ and stars consist of colliding meteoric stones in different stages of condensation.

[1] Inaugural address at the meeting of the British Association for the Advancement of Science, at Cardiff, August, 1891, by William Huggins, president of the association (Nature, Aug. 20).

More recently the view has been put forward that the diversified spectra of the stars do not represent the stages of an evolutional progress, but are due for the most part to differences of original constitution.

The few minutes which can be given to this part of the address are insufficient for a discussion of these different views. I purpose, therefore, to state briefly, and with reserve, as the subject is obscure, some of the considerations from the characters of their spectra which appeared to me to be in favor of the evolutional order in which I arranged the stars from their photographic spectra in 1879. This order is essentially the same as Vogel had previously proposed in his classification of the stars in 1874, in which the white stars, which are most numerous, represent the early adult and most persistent stage of stellar life, the solar condition that of full maturity and of commencing age, while in the orange and red stars with banded spectra we see the setting in and advance of old age. But this statement must be taken broadly, and not as asserting that all stars, however different in mass and possibly to some small extent in original constitution, exhibit one invariable succession of spectra.

In the spectra of the white stars the dark metallic lines are relatively inconspicuous, and occasionally absent, at the same time that the dark lines of hydrogen are usually strong, and more or less broad, upon a continuous spectrum, which is remarkable for its brilliancy at the blue end. In some of these stars the hydrogen and some other lines are bright, and sometimes variable.

As the greater or less prominence of the hydrogen lines, dark or bright, is characteristic of the white stars as a class, and diminishes gradually with the incoming and increase in strength of the other lines, we are probably justified in regarding it as due to some conditions which occur naturally during the progress of stellar life, and not to a peculiarity of original constitution.

To produce a strong absorption-spectrum a substance must be at the particular temperature at which it is notably absorptive; and, further, this temperature must be sufficiently below that of the region behind from which the light comes for the gas to appear, so far as its special rays are concerned, as darkness upon it. Considering the high temperature to which hydrogen must be raised before it can show its characteristic emission and absorption, we shall probably be right in attributing the relative feebleness or absence of the other lines, not to the paucity of the metallic vapors, but rather to their being so hot relatively to the substances behind them as to show feebly, if at all, by reversion. Such a state of things would more probably be found, it seems to me, in conditions anterior to the solar stage. A considerable cooling of the sun would probably give rise to banded spectra due to compounds, or to more complex molecules, which might form near the condensing points of the vapors.

The sun and stars are generally regarded as consisting of glowing vapors surrounded by a photosphere where condensation is taking place, the temperature of the photospheric layer from which the greater part of the radiation comes being constantly renewed from the hotter matter within.

At the surface the convection currents would be strong, producing a considerable commotion, by which the different gases would be mixed and not allowed to retain the inequality of proportions at different levels due to their vapor densities.

Now the conditions of the radiating photosphere and those of the gases above it, on which the character of the spectrum of a star depends, will be determined, not alone by temperature, but also by the force of gravity in these regions: this force will be fixed by the star's mass and its stage of condensation, and will become greater as the star continues to condense.

In the case of the sun the force of gravity has already become so great at the surface that the decrease of the density of the gases must be extremely rapid, passing in the space of a few miles from atmospheric pressure to a density infinitesimally small; consequently the temperature-gradient at the surface, if determined solely by expansion, must be extremely rapid. The gases here, however, are exposed to the fierce radiation of the sun, and unless wholly transparent would take up heat, especially if any solid or liquid particles were present from condensation or convection currents.

From these causes, within a very small extent of space at the surface of the sun, all bodies with which we are acquainted should fall to a condition in which the extremely tenuous gas could no longer give a visible spectrum. The insignificance of the angle subtended by this space as seen from the earth should cause the boundary of the solar atmosphere to appear defined. If the boundary which we see be that of the sun proper, the matter above it will have to be regarded as in an essentially dynamical condition — an assemblage, so to speak, of gaseous projectiles for the most part falling back upon the sun after a greater or less range of flight. But in any case it is within a space of relatively small extent in the sun, and probably in the other solar stars, that the reversion which is manifested by dark lines is to be regarded as taking place.

Passing backward in the star's life, we should find a gradual weakening of gravity at the surface, a reduction of the temperature-gradient so far as it was determined by expansion, and convection currents of less violence producing less interference with the proportional quantities of gases due to their vapor densities, while the effects of eruptions would be more extensive.

At last we might come to a state of things in which, if the star were hot enough, only hydrogen might be sufficiently cool relatively to the radiation behind to produce a strong absorption. The lower vapors would be protected, and might continue to be relatively too hot for their lines to appear very dark upon the continuous spectrum; besides, their lines might be possibly to some extent effaced by the coming in under such conditions in the vapors themselves of a continuous spectrum.

In such a star the light radiated towards the upper part of the atmosphere may have come from portions lower down of the atmosphere itself, or at least from parts not greatly hotter. There may be no such great difference of temperature of the low and less low portions of the star's atmosphere as to make the darkening effect of absorption of the protected metallic vapors to prevail over the illuminating effect of their emission.

It is only by a vibratory motion corresponding to a very high temperature that the bright lines of the first spectrum of hydrogen can be brought out, and by the equivalence of absorbing and emitting power that the corresponding spectrum of absorption should be produced; yet for a strong absorption to show itself, the hydrogen must be cool relatively to the source of radiation behind it, whether this be condensed particles or gas. Such conditions, it seems to me, should occur in the earlier rather than in the more advanced stages of condensation.

The subject is obscure, and we may go wrong in our mode of conceiving of the probable progress of events, but there can be no doubt that in one remarkable instance the white-star spectrum is associated with an early stage of condensation.

Sirius is one of the most conspicuous examples of one type of this class of stars. Photometric observations combined with its ascertained parallax show that this star emits from forty to sixty times the light of our sun, even to the eye, which is insensible to ultra-violet light, in which Sirius is very rich, while we learn from the motion of its companion that its mass is not much more than double that of our sun. It follows that, unless we attribute to this star an improbably great emissive power, it must be of immense size, and in a much more diffuse and therefore an earlier condition than our sun; though probably at a later stage than those white stars in which the hydrogen lines are bright.

A direct determination of the relative temperature of the photospheres of the stars might possibly be obtained in some cases from the relative position of maximum radiation of their continuous spectra. Langley has shown that through the whole range of temperature on which we can experiment, and presumably at temperatures beyond, the maximum of radiation-power in solid bodies gradually shifts upwards in the spectrum from the infra red through the red and orange, and that in the sun it has reached the blue.

The defined character, as a rule, of the stellar lines of absorption suggests that the vapors producing them do not at the same time exert any strong power of general absorption. Consequently, we should probably not go far wrong, when the photosphere consists of liquid or solid particles, if we could compare select parts of the continuous spectrum between the stronger lines, or where they are fewest. It is obvious that, if extended portions of different stellar spectra were compared, their true relation would be obscured by the line-absorption.

The increase of temperature, as shown by the rise in the spectrum of the maximum of radiation, may not always be accompanied by a corresponding greater brightness of a star as estimated by the eye, which is an extremely imperfect photometric instrument. Not only is the eye blind to large regions of radiation, but even for the small range of light that we can see the visual effect varies enormously with its color. According to Professor Langley, the same amount of energy which just enables us to perceive light in the crimson at A would in the green produce a visual effect 100,000 times greater. In the violet the proportional effect would be 1,600, in the blue 62,000, in the yellow 28,000, in the orange 14,000, and in the red 1,200. Captain Abney's recent experiments make the sensitiveness of the eye for the green near F to be 750 times greater than for the red about C. It is for this reason, at least in part, that I suggested in 1864, and have since shown by direct observation, that the spectrum of the nebula in Andromeda, and presumably of similar nebulæ, is, in appearance, only wanting in the red.

The stage at which the maximum radiation is in the green, corresponding to the eye's greatest sensitiveness, would be that in which it could be most favorably measured by eye-photometry. As the maximum rose into the violet and beyond, the star would increase in visual brightness, but not in proportion to the increase of energy radiated by it.

The brightness of a star would be affected by the nature of the substance by which the light was chiefly emitted. In the laboratory, solid carbon exhibits the highest emissive power. A stellar stage in which radiation comes, to a large extent, from a photosphere of the solid particles of this substance, would be favorable for great brilliancy. Though the stars are built up of matter essentially similar to that of the sun, it does not follow that the proportion of the different elements is everywhere the same. It may be that the substances condensed in the photospheres of different stars may differ in their emissive powers, but probably not to a great extent.

All the heavenly bodies are seen by us through the tinted medium of our atmosphere. According to Langley, the solar stage of stars is not really yellow, but, even as gauged by our imperfect eyes, would appear bluish-white if we could free ourselves from the deceptive influence of our surroundings.

From these considerations it follows that we can scarcely infer the evolutional stages of the stars from a simple comparison of their eye-magnitudes. We should expect the white stars to be, as a class, less dense than the stars in the solar stage. As great mass might bring in the solar type of spectrum at a relatively earlier time, some of the brightest of these stars may be very massive, and brighter than the sun — for example, the brilliant star Arcturus. For these reasons the solar stars should not only be denser than the white stars, but perhaps, as a class, surpass them in mass and eye-brightness.

It has been shown by Lane that, so long as a condensing gaseous mass remains subject to the laws of a purely gaseous body, its temperature will continue to rise.

The greater or less breadth of the lines of absorption of hydrogen in the white stars may be due to variations of the depth of the hydrogen in the line of sight, arising from the causes which have been discussed. At the sides of the lines the absorption and emission are feebler than in the middle, and would come out more strongly with a greater thickness of gas.

The diversities among the white stars are nearly as numerous as the individuals of the class. Time does not permit me to do more than record that, in addition to the three sub-classes into which they have been divided by Vogel, Scheiner has recently investigated minor differences as suggested by the character of the third line of hydrogen near G. He has pointed out, too, that so far as his observations go the white stars in the constellation of Orion stand alone, with the exception of Algol, in possessing a dark line in the blue which has apparently the same position as a bright line in the great nebula of the same constellation; and Pickering finds in his photographs of the spectra of these stars dark lines corresponding to the principal lines of the bright-line stars, and the planetary nebulæ with the exception of the chief nebular lines. The association of white stars with nebular matter in Orion, in the Pleiades, in the region of the Milky Way, and in other parts of the heavens, may be regarded as falling in with the view that I have taken.

In the stars possibly further removed from the white class than our sun, belonging to the first division of Vogel's third class, which are distinguished by absorption bands with their stronger edge towards the blue, the hydrogen lines are narrower than in the solar spectrum. In these stars the density-gradient is probably still more rapid, the depths of hydrogen may be less, and possibly the hydrogen molecules may be affected by a larger number of encounters with dissimilar molecules. In some red stars with dark hydrocarbon bands, the hydrogen lines have not been certainly observed; if they are really absent, it may be because the temperature has fallen below the point at which hydrogen can exert its characteristic absorption; besides, some hydrogen will have united with the carbon. The coming in of the hydrocarbon bands may indicate a later evolutional stage, but the temperature may still be high, as acetylene can exist in the electric arc.

A number of small stars more or less similar to those which are known by the names of their discoverers, Wolf and Rayet, have been found by Pickering in his photographs. These are remarkable for several brilliant groups of bright lines, including frequently the hydrogen lines and the line D_3, upon a continuous spectrum strong in blue and violet rays, in which are also dark lines of absorption. As some of the bright groups appear in his photographs to agree in position with corresponding bright lines in the planetary nebulæ, Pickering suggests that these stars should be placed in one class with them, but the brightest nebular line is absent from these stars. The simplest conception of their nature would be that each star is surrounded by a nebula, the bright groups being due to the gaseous matter outside the star. Mr. Roberts, however, has not been able to bring out any indication of nebulosity by prolonged exposure. The remarkable star η Argus may belong to this class of the heavenly bodies.

In the nebulæ, the elder Herschel saw portions of the fiery mist or "shining fluid" out of which the heavens and the earth had been slowly fashioned. For a time this view of the nebulæ gave place to that which regarded them as external galaxies, cosmical "sand-heaps," too remote to be resolved into separate stars; though indeed, in 1858, Mr. Herbert Spencer showed that the observations of nebulæ up to that time were really in favor of an evolutional progress.

In 1864 I brought the spectroscope to bear upon them: the bright lines which flashed upon the eye showed the source of the light to be glowing gas, and so restored these bodies to what is probably their true place, as an early stage of sidereal life.

At that early time our knowledge of stellar spectra was small. For this reason partly, and probably also under the undue influence of theological opinions then widely prevalent, I unwisely wrote in my original paper in 1864, "that in these objects we no longer have to do with a special modification of our own type of sun, but find ourselves in presence of objects possessing a distinct and peculiar plan of structure." Two years later, however, in a lecture before this association, I took a truer position. "Our views of the universe," I said, "are undergoing important changes: let us wait for more facts, with minds unfettered by any dogmatic theory, and therefore free to receive their teaching, whatever it may be, of new observations."

Let us turn aside for a moment from the nebulæ in the sky to the conclusions to which philosophers had been irresistibly led by a consideration of the features of the solar system. We have before us in the sun and planets obviously not a haphazard aggregation of bodies, but a system resting upon a multitude of relations pointing to a common physical cause. From these considerations Kant and Laplace formulated the nebular hypothesis, resting it on gravitation alone, for at that time the science of the conservation of energy was practically unknown. These philosophers showed how, on the supposition that the space now occupied by the solar system was once filled by a vaporous mass, the formation of the sun and planets could be reasonably accounted for.

By a totally different method of reasoning, modern science traces the solar system backward step by step to a similar state of things at the beginning. According to Helmholtz, the sun's heat is maintained by the contraction of his mass, at the rate of about 220 feet a year. Whether at the present time the sun is getting hotter or colder we do not certainly know. We can reason back to the time when the sun was sufficiently expanded to fill the whole space occupied by the solar system, and was reduced to a great glowing nebula. Though man's life, the life of the race perhaps, is too short to give us direct evidence of any distinct stages of so august a process, still the probability is great that the nebular hypothesis, especially in the more precise form given to it by Roche, does represent broadly, notwithstanding some difficulties, the succession of events through which the sun and planets have passed.

The nebular hypothesis of Laplace requires a rotating mass of fluid which at successive epochs became unstable from excess of motion, and left behind rings, or more probably perhaps lumps, of matter from the equatorial regions.

The difficulties to which I have referred have suggested to some thinkers a different view of things, according to which it is not necessary to suppose that one part of the system gravitationally supports another. The whole may consist of a congeries of discrete bodies, even if these bodies be the ultimate molecules of matter. The planets may have been formed by the gradual accretion of such discrete bodies. On the view that the material of the condensing solar system consisted of separate particles or masses, we have no longer the fluid pressure which is an essential part of Laplace's theory. Faye, in his theory of evolution from meteorites, has to throw over this fundamental idea of the nebular hypothesis, and he formulates instead a different succession of events, in which the outer planets were formed last, a theory which has difficulties of its own.

Professor George Darwin has recently shown, from an investigation of the mechanical conditions of a swarm of meteorites, that on certain assumptions a meteoric swarm might behave as a coarse gas, and in this way bring back the fluid pressure exercised by one part of the system on the other, which is required by Laplace's theory. One chief assumption consists in supposing that such inelastic bodies as meteoric stones might attain the effective elasticity of a high order which is necessary to the theory through the sudden volatilization of a part of their mass at an encounter, by which what is virtually a violent explosive is introduced between the two colliding stones. Professor Darwin is careful to point out that it must necessarily be obscure as to how a small mass of solid matter can take up a very large amount of energy in a small fraction of a second.

Any direct indications from the heavens themselves, however slight, are of so great value, that I should perhaps in this connection call attention to a recent remarkable photograph, by Mr. Roberts, of the great nebula in Andromeda. On this plate we seem to have presented to us some stage of cosmical evolution on a gigantic scale. The photograph shows a sort of whirlpool disturbance of the luminous matter which is distributed in a plane inclined to the line of sight, in which a series of rings of bright matter separated by dark space, greatly foreshortened by perspective, surround a large undefined central mass. We are ignorant of the parallax of this nebula, but there can be little doubt that we are looking upon a system very remote, and therefore of a magnitude greatly beyond our power of adequate comprehension. The matter of this nebula, in whatever state it may be, appears to be distributed, as in so many other nebulæ, in rings or spiral streams, and to suggest a stage in a succession of evolutional events not inconsistent with that which the nebular hypothesis requires. To liken this object more directly to any particular stage in the formation of the solar system would be "to compare things great with small," and might be indeed to introduce a false analogy; but, on the other hand, we should err through an excess of caution if we did not accept the remarkable features brought to light by this photograph as a presumptive indication of a progress of events in cosmical history following broadly upon the lines of Laplace's theory.

The old view of the original matter of the nebulæ, that it consisted of a "fiery mist,"

> "a tumultuous cloud
> Instinct with fire and nitre,"

fell at once with the rise of the science of thermodynamics. In 1854 Helmholtz showed that the supposition of an original fiery condition of the nebulous stuff was unnecessary, since in the mutual gravitation of widely separated matter we have a store of potential energy sufficient to generate the high temperature of the sun and stars. We can scarcely go wrong in attributing the light of the nebulæ to the conversion of the gravitational energy of shrinkage into molecular motion.

The idea that the light of comets and of nebulæ may be due to a succession of ignited flashes of gas from the encounters of meteoric stones was suggested by Professor Tait, and was brought to the notice of this association in 1871 by Sir William Thomson in his presidential address.

The spectrum of the bright-line nebulæ is certainly not such a spectrum as we should expect from the flashing by collisions of meteorites similar to those which have been analyzed in our laboratories. The strongest lines of the substances which in the case of such meteorites would first show themselves, iron, sodium, magnesium, nickel, etc., are not those which distinguish the nebular spectrum. On the contrary, this spectrum is chiefly remarkable for a few brilliant lines, very narrow and defined, upon a background of a faint continuous spectrum, which contains numerous bright lines, and probably some lines of absorption.

The two most conspicuous lines have not been interpreted, for though the second line falls near, it is not coincident with a strong double line of iron. It is hardly necessary to say that though the near position of the brightest line to the bright double line of nitrogen, as seen in a small spectroscope in 1864, naturally suggested at that early time the possibility of the presence of this element in the nebulæ, I have been careful to point out, to prevent misapprehension, that in more recent years the nitrogen line and subsequently a lead line have been employed by me solely as fiducial points of reference in the spectrum.

The third line we know to be the second line of the first spectrum of hydrogen. Mr. Keeler has seen the first hydrogen spectrum in the red, and photographs show that this hydrogen spectrum is probably present in its complete form, or nearly so, as we first learned to know it in the absorption spectrum of the white stars.

We are not surprised to find associated with it the line D_3, near the position of the absent sodium lines, probably due to the atom of some unknown gas, which in the sun can only show itself in the outbursts of highest temperature, and for this reason does not reveal itself by absorption in the solar spectrum.

It is not unreasonable to assume that the two brightest lines, which are of the same order, are produced by substances of a similar nature, in which a vibratory motion corresponding to a very high temperature is also necessary. These substances, as well as that represented by the line D_3, may be possibly some of the unknown elements which are wanting in our terrestrial chemistry between hydrogen and lithium, unless indeed D_3 be on the lighter side of hydrogen.

In the laboratory we must have recourse to the electric discharge to bring out the spectrum of hydrogen; but in a vacuum-tube, though the radiation may be great, from the relative fewness of the luminous atoms or molecules or from some other cause, the temperature of the gas as a whole may be low.

On account of the large extent of the nebulæ, a comparatively small number of luminous molecules or atoms would probably be sufficient to make the nebulæ as bright as they appear to us. On such an assumption the average temperature may be low, but the individual particles, which by their encounters are luminous, must have motions corresponding to a very high temperature, and in this sense be extremely hot.

In such diffuse masses, from the great mean length of free path, the encounters would be rare but correspondingly violent, and tend to bring about vibrations of comparatively short period, as appears to be the case if we may judge by the great relative brightness of the more refrangible lines of the nebular spectrum.

Such a view may perhaps reconcile the high temperature which the nebular spectrum undoubtedly suggests with the much lower mean temperature of the gaseous mass, which we should expect at so early a stage of condensation, unless we assume a very enormous mass, or that the matter coming together had previously considerable motion, or considerable molecular agitation.

The inquisitiveness of the human mind does not allow us to remain content with the interpretation of the present state of the cosmical masses, but suggests the question,

"What see'st thou else
In the dark backward and abysm of time?"

What was the original state of things? How has it come about that by the side of ageing worlds we have nebulæ in a relatively younger stage? Have any of them received their birth from dark suns, which have collided into new life, and so belong to a second or later generation of the heavenly bodies?

During the short historic period, indeed, there is no record of such an event; still it would seem to be only through the collision of dark suns, of which the number must be increasing, that a temporary rejuvenescence of the heavens is possible, and by such ebbings and flowings of stellar life that the inevitable end to which evolution in its apparently uncompensated progress is carrying us can, even for a little, be delayed

We cannot refuse to admit as possible such an origin for nebulæ.

In considering, however, the formation of the existing nebulæ we must bear in mind that, in the part of the heavens within our ken, the stars still in the early and middle stages of evolution exceed greatly in number those which appear to be in an advanced condition of condensation. Indeed, we find some stars which may be regarded as not far advanced beyond the nebular condition.

It may be that the cosmical bodies which are still nebulous owe their later development to some conditions of the part of space where they occur, such as, conceivably, a greater original homogeneity, in consequence of which condensation began less early. In other parts of space, condensation may have been still further delayed, or even have not yet begun. It is worthy of remark that these nebulæ group themselves about the Milky Way, where we find a preponderance of the white-star type of stars, and almost exclusively the bright-line stars which Pickering associates with the planetary nebulæ. Further, Dr. Gill concludes, from the rapidity with which they impress themselves upon the plate, that the fainter stars of the Milky Way also, to a large extent, belong to this early type of stars. At the same time other types of stars occur also over this region, and the red hydrocarbon stars are found in certain parts; but possibly these stars may be before or behind the Milky Way, and not physically connected with it.

If light matter be suggested by the spectrum of these nebulæ, it may be asked further, as a pure speculation, whether in them we are witnessing possibly a later condensation of the light matter which had been left behind, at least in a relatively greater proportion, after the first growth of worlds into which the heavier matter condensed, though not without some entanglement of the lighter substances. The wide extent and great diffuseness of this bright-line nebulosity over a large part of the constellation of Orion may be regarded perhaps as pointing in this direction. The diffuse nebulous matter streaming round the Pleiades may possibly be another instance, though the character of its spectrum has not yet been ascertained.

In the planetary nebulæ, as a rule, there is a sensible increase of the faint continuous spectrum, as well as a slight thickening of the bright lines towards the centre of the nebula, appearances which are in favor of the view that these bodies are condensing gaseous masses.

Professor George Darwin, in his investigation of the equilibrium of a rotating mass of fluid, found, in accordance with the independent researches of Poincaré, that when a portion of the central body becomes detached through increasing angular velocity, the portion should bear a far larger ratio to the remainder than is observed in the planets and satellites of the solar system, even taking into account he terogeneity from the condensation of the parent mass.

Now this state of things, in which the masses, though not equal, are of the same order, does seem to prevail in many nebulæ, and to have given birth to a large number of binary stars. Mr. See has recently investigated the evolution of bodies of this class, and points out their radical differences from the solar system in the relatively large mass-ratios of the component bodies, as well as in the high eccentricities of their orbits brought about by tidal friction, which would play a more important part in the evolution of such systems.

Considering the large number of these bodies, he suggests that the solar system should perhaps no longer be regarded as representing celestial evolution in its normal form —

"A goodly Paterne to whose perfect mould
He fashioned them . . ."—

but rather as modified by conditions which are exceptional.

It may well be that in the very early stages condensing masses are subject to very different conditions, and that condensation may not always begin at one or two centres, but sometimes set in at a large number of points, and proceed in the different cases along very different lines of evolution.

(To be continued.)

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.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Solar Diffraction Glow.

A FAINT yet clearly perceptible diffraction ring has appeared around the sun for about a week past. It had a pale purplish tint, and at the outer margin faded into the blue sky by almost imperceptible degrees. The centre was tinted nearly to the sun, and was not so bright and white as was the case in Bishop's ring in 1883-85. The part of the ring at 22½ degrees from the sun was little if any brighter than the parts adjacent. The outer margin of the ring reached to 30 degrees, and some days perhaps to 35 degrees. The storms of late September and first days of October cleared away and left the deep blue sky without a cloud or even haze. The colored ring could not be definitely recognized till about noon. After that time it grew brighter till sunset, when the part of the ring which remained above the horizon rapidly changed to a most brilliant violet-purple. The illuminated portion of the sky at sunset was nearly semi-circular and had a greater diameter than the tinted ring of the afternoon, but where the ring had been perceptible during the day, the twilight tints were most intense.

These observations were made in the San Juan Mountains in Colorado, at an altitude of 10,800 feet. I observed Bishop's ring for about two years, and this ring is in several respects different from that. G. H. STONE.

Ironton, Col., Oct. 12.

Rain-Making.

REASONING from well-established meteorological principles alone, I should say that the probabilities of success in rain-making are quite small. But we have learned that it is hazardous to predict confidently, *a priori*, what nature may do under untried conditions. New principles may be discovered which may modify the operation of those already known. As far as I am informed, reports concerning the results of the experiments being made in the South-west are contradictory. And if rain does follow a few explosions there at this season of the year, when rains occur in most portions of the temperate zones, would that settle the question without dispute?

It seems to me that the effects following great battles have not been recorded with sufficient care to furnish reliable data. When the air in any region is nearly saturated with moisture, it is reasonable to suppose that a violent disturbance in the atmosphere may cause a sufficient condensation to produce rain. But when it is far below saturation, it seems to me that the results must be doubtful until fully established by experiment. Let the experiments be made in places where it seldom or never rains — for instance, in the Sahara. A series of such experiments would determine the question without doubt. I await results with great interest. MARSHALL HENSHAW.

Amherst, Mass., Oct. 14.

AMONG THE PUBLISHERS.

A BOOK has just been published entitled "The Business of Travel," a fifty years' record of progress, by Fraser Rae, giving in detail an account of the origin and growth of the now marvellously developed organization of Thomas Cook & Son. To scores of thousands who have made pilgrimages to the Meccas of the world as excursionists, guided, directed, and conserved in all interests by this concern, this book, which is packed with information as to travel in this country, in Europe, and in Eastern lands, will be found not only entertaining but instructive.

— The *Publishers' Weekly* says, that, in response to an inquiry, the Assistant Secretary of the Treasury writes the following, which will be of interest to all bookbuyers: "In reply to your letter in which you inquire if you can purchase books in England and have them sent to you by mail, I have to inform you that the importation of dutiable articles, which includes dutiable books, is forbidden by Article XI. of the Universal Postal Union Convention, and books so imported are subject to seizure. Books printed exclusively in languages other than English, and various other books, are exempt from duty under certain provisions of the Free List, Act of Oct. 1, 1890, and such books are not included in the prohibition.

— John Wiley & Sons have in preparation a "Manual of Mining," by Professor M. C. Ihlseng.

— There has been no book written on Hawaii, or the Sandwich Islands, as many still call them, within the last twenty years. But this silence will soon be broken by Mrs. Helen Mather, who has written an account of "One Summer in Hawaii," which the Cassell Publishing Company will publish. Mrs. Mather's book will undoubtedly turn the attention of many travellers toward this little group of islands in the Pacific. It will be illustrated from photographs and drawings made by Walter McDougall, who has had the pleasure of spending part of the summer in Hawaii.

— Miss Isabel F. Hapgood has translated a large number of Tolstóy's books, and Miss Isabel F. Hapgood has been journeying in Russia. What more natural than that she should see "Count Tolstóy at Home," and what still more natural than that she should make this the title and subject of a paper in the November *Atlantic*. Miss Hapgood, although admiring his great gifts, is not a blind adherent of his changeable philosophies. Here is a bit of useful information: the name Tolstóy with the *y* is the writer's own way of spelling his own name, and not a typographical error.

— Little, Brown, & Co. have just ready the ninth edition of Bartlett's "Familiar Quotations," greatly enlarged, and now representing eight hundred and fifty authors and twelve thousand new lines of index, making the volume one-third larger than the previous edition; and "A Narrative of Events Connected with the Introduction of Sulphuric Ether into Surgical Use," by Richard Manning Hodges, A.M., M.D., formerly of the Massachusetts General Hospital.

— All teachers who are interested in seeing the best masterpieces of literature put before school children in an attractive and inexpensive form will be gratified to learn that Houghton, Mifflin, & Co. have just issued, as No. 51 of their Riverside Literature Series (price, in paper covers, 15 cents), "Rip Van Winkle and other American Essays from Washington Irving's Sketch Book." In addition to "Rip Van Winkle," the book contains the famous "Legend of Sleepy Hollow," "Philip of Pokanoket," introductions and explanatory notes, and a biographical sketch of the author. Early in December, No. 52 of the same series will appear, containing "The Voyage and other English Essays from the Sketch Book."

— The Peruvian traveller and linguist, J. J. von Tschudi, lately deceased, had been successful in collecting almost all the books, pamphlets, and treatises that had ever appeared in the Quichua language, still the most important idiom of that extensive country. Among the few oldest books which he had never been able to see is the grammar of the Dominican priest Domingo de Sancto Thomas, "Arte de la lengua Quichua." The well-known republisher of South American linguistic books, Dr. Julius Platzmann, has been fortunate enough to secure a copy at a pretty steep price, and has now reproduced it in a fac-simile edition, for sale at B. G. Teubner's, Leipzig. It is a neat little sedecimo in small Gothic print, containing a *prologo* and ninety-six leaves (192 pages). Old Indian grammars of those times are fashioned after the model of the Latin language, and this one makes no exception. It was the first grammar of the Quichua language, and evinces an uncommonly thorough study of it. It is dated Valladolid, 1560. The Quichua lexicon of this author is of the same date, and is the first print in which the name "Quichua," which is the name of a Peruvian tribe of the Andahuaylas district, has been applied to this language.

— Messrs. J. B. Lippincott Company announce for early publication the "Life of Benjamin Harris Brewster," by Eugene Coleman Savidge, M.D. Mr. Brewster took an active and important part in many of the most critical and exciting movements in our recent national history. He knew more or less intimately every American celebrity since the time of Webster and Clay, and his biography will be a valuable contribution to the history of the last half-century of our national life. The second volume of "Hermetic Philosophy," by Styx of the "H. B. of L." will soon be issued by the same publishers. As in the first volume, it includes lessons, general discourses, and explanations of "Fragments" from the schools of Egypt, Chaldea, Greece, Italy, etc., and is a continuation of the line of thought treated in that work. One of the acquisitions to medical literature of the year will be the new edition of Professor Roberts Bartholow's "Hypodermatic Medication," about to be issued from the press of the same company.

— The J. B. Lippincott Company of Philadelphia have published an octavo volume entitled "Harmony of Ancient History," by Malcomb Macdonald. It is an attempt to determine the dates of the best known events in Oriental History and to harmonize the chronology of the Egyptians with that of the Jews. Our knowledge of Egyptian chronology was formerly confined to the statements of the Greek historian Manetho, but we now have the testimony of the Egyptian monuments to aid us; yet the best modern authorities differ by many centuries as to the dates of Egyptian kings. On the other hand, the Bible chronology, besides being sometimes inconsistent with itself, is not in accord with that of Egypt and other nations, and the result is a mass of doubt and confusion. Mr. Macdonald has here endeavored to fix the dates of some Egyptian kings by means of astronomical phenomena recorded on the monuments whose occurrence our modern astronomy enables us to verify. He then proceeds to the Jewish chronology with the avowed purpose of showing that it harmonizes with that of Egypt and Assyria; and he claims for his scheme that "there is not one single chronological statement in the Bible from which it does not remove all improbability." To attain this end, however, he is obliged to resort to some devices and interpretations that seem forced and arbitrary, and he admits that "the whole scheme rests largely on circumstantial evidence." For our part we doubt if any reconciliation of the ancient chronologies is possible, the gaps in the monumental records being so great and other ancient histories so largely mythical as to preclude a satisfactory solution of the problem; but Mr. Macdonald has made an elaborate attempt at such reconciliation, and we leave the criticism of his work to those who have made a special study of the subject.

— The newest of important educational movements, "University Extension," will have first place in the *Popular Science Monthly* for November. The article is by Professor C. Hanford Henderson, and, after sketching what has been done in England, it describes the beginning that has been made in this country, and tells the plans of the extension organizers for the future. In the same number Mr. W. F. Durfee will conclude his contributions to the series of illustrated articles on the development of American industries with a paper on "The Manufacture of Steel." This paper completes the account of the Bessemer process, and proves

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Publications received at Editor's Office, Oct. 14–20.

BARNES, M. S., and BARNES, E. Studies in American History. Boston, Heath. 431 p. 12°. $1.25.
GREENE, D. An Introduction to Spherical and Practical Astronomy. Boston, Ginn. 158 p. 8°. $1.60.
HARVARD COLLEGE, Annals of the Astronomical Observatory of. Vol. XXVI, Part I. Preparation and Discussion of the Draper Catalogue. Cambridge, University Press. 192 p. 4°.
—— Annals of the Astronomical Observatory of. Vol. XXX, Part II. Observations made at the Blue Hill Meteorological Observatory, in the year 1890. Cambridge, University Press. 201 p. 4°.
WHITING, H. A course of Experiments in Physical Measurements. Part IV. Appendix for the use of Teachers. Boston, Heath. 326 p. 8°.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

For Sale or Exchange for books a complete private chemical laboratory outfit. Includes large Becker balance (200g to 1-10mg), platinum dishes and crucibles, agate m tors, glass-blowing apparatus, etc. For sale in part or whole. Also complete file of *Silliman's Journal*, 1862–1885 (62-71 bound); Smithsonian Reports, 1854–1883; U. S. Coast Survey 1854–1869. Full particulars to enquirers. F. GARDINER, JR., Pomfret, Conn.

I have five vols. of "Olhausen's Biblical Commentary on the New Testament" that I would like to sell or exchange for works on geology of North America. These volumes are as good as new, except the slight fading of the black cloth covers. D. T. Marshall, Metuchen, N. J.

For sale or exchange, extra fine pair (♂ and ♀) of skins of Rocky Mountain Goat, with the skulls, etc., as needed for mounting; collection of vertebrate fossils from the Coup Fork Tertiary of Kansas; collection of works on descriptive cryptogamic botany—mostly on *Fungi*; thirteen vols. of *Botanical Gazette*, eight vols *Grevillea*, four vols. *Notarisea*; stereopticon outfit, with attachment for microscopic projection; 148 stereopticon slides, illustrating zoology and cryptogams. Wanted—American and foreign works and pamphlets on Vertebrate Palæontology, and series of *Am. Jour. of Science* and other periodicals containing contributions to Vertebrate Palæontology. Prof. F. W. Cragin, Colorado Springs, Colo.

For exchange or sale at a sacrifice, an elaborate microscope outfit. Bullock stand; monocular objectives, one-sixth homogeneous immersion, four-tenths, and three inch, Bausch & Lomb, also one-fourth and one inch Spencer. Four eye-pieces. Objectives are the best made. Address Mrs. Marion Smith, 41 Branch Street, Lowell, Mass.

that its chief feature was first developed by an American. The same i-sue will contain an article by Professor Frederick Starr on "Ornament;" one by President Goodale (h's address to the American Association for the Advancement of Science) on "Some of the Possibilities of Economic Botany;" and the second of the "Lessons from the Census," by Mr. Carroll D. Wright.

— Bradlee Whidden will publish, about Nov. 15, "Modern American Rifles," by A. C. Gould (Ralph Greenwood), a work which will discuss the merits and capabilities as well as the advancement made in the American rifle.

— The *Chautauquan* for November has several illustrated articles and the portraits of a number of prominent women. The following titles are from the table of contents: "Physical Life," II., by Milton J. Greenman; "National Agencies for Scientific Research," II., by Major J. W. Powell; "The Adulteration of Foods," by Guilford L. Spencer; "Potters and Their Craft," by Thomas B. Preston; "Social Science in the Pulpit," by John Habberton; "People and Places," by Daniel C. Gilman, LL.D.; "Women's Clubs in London," by Elizabeth Robins Pennell; "Among the Creoles," by Mary L. Schaffter; "The Prevention of Crime," by Mrs. Kate Tannatt Woods; "Women as Astronomers" (first paper), by Esther Singleton; and "Cremation," by Anna Churchell Carey.

— D. C. Heath & Co., Boston, will issue in November "Herbert's Allgemeine Pädagogik," translated by Henry M. Felkin of London, and edited, with an introduction, by Oscar Browning, author of "Educational Theories."

— In the November issue of the *New England Magazine*, Walter Blackburn Harte makes a plea for a world without books. He thinks that education is not an unmixed blessing, as the greater the intelligence of individuals and peoples the greater is their capacity for suffering.

SCIENCE

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RUDYARD KIPLING.

A NOVEL BY RUDYARD KIPLING,

Written in collaboration with a young American author, Wolcott Balestier, and entitled "The Naulahka," a tale of West and East. This begins in the November CENTURY.

THREE OTHER SERIAL STORIES

Will be printed during the year. These are by Mrs. Burton Harrison, author of "The Anglomaniacs," Dr. Weir Mitchell, and Mary Hallock Foote. Mrs. Harrison will again write of society life in New York. Dr. Mitchell's novel is entitled "Characteristics," and Mrs. Foote's "The Chosen Valley," a novel of the Great West.

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Philosophical Society, Washington.

Oct. 24. — Frank H. Bigelow, An Account of the Experiments for Eliminating the Error of Personal Equation from Stellar Transits by Photography (with exhibition of instruments and photographic negatives); John W. Hoyt, The Present Status and Prospects of the Project for a National University; Thomas Wilson, The National Postal and School Savings Bank System of Belgium.

Natural Science Association of Staten Island.

Oct. 10. — Charles W. Leng, Notes on the Tribe Hispini.

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SCIENCE

NEW YORK, OCTOBER 30, 1891.

CELESTIAL PHYSICS.[1]

(Continued from p. 234.)

Besides its more direct use in the chemical analysis of the heavenly bodies, the spectroscope has given to us a great and unexpected power of advance along the lines of the older astronomy. In the future a higher value may, indeed, be placed upon the indirect use of the spectroscope than upon its chemical relations.

By no direct astronomical methods could motions of approach or of recession of the stars be even detected, much less could they be measured. A body coming directly towards us or going directly from us appears to stand still. In the case of the stars we can receive no assistance from change of size or of brightness. The stars show no true disks in our instruments, and the nearest of them is so far off that if it were approaching us at the rate of a hundred miles in a second of time, a whole century of such rapid approach would not do more than increase its brightness by the one-fortieth part.

Still it was only too clear that so long as we were unable to ascertain directly those components of the stars' motions which lie in the line of sight, the speed and direction of the solar motion in space, and many of the great problems of the constitution of the heavens, must remain more or less imperfectly known. Now the spectroscope has placed in our hands this power, which, though so essential, appeared almost in the nature of things to lie forever beyond our grasp: it enables us to measure directly, and under favorable circumstances to within a mile per second, or even less, the speed of approach or of recession of a heavenly body. This method of observation has the great advantage for the astronomer of being independent of the distance of the moving body, and is therefore as applicable and as certain in the case of a body on the extreme confines of the visible universe, so long as it is bright enough, as in the case of a neighboring planet.

Doppler had suggested as far back as 1841 that the same principle on which he had shown that a sound should become sharper or flatter if there were an approach or a recession between the ear and the source of the sound, would apply equally to light; and he went on to say that the difference of color of some of the binary stars might be produced in this way by their motions. Doppler was right in that the principle is true in the case of light, but he was wrong in the particular conclusion which he drew from it. Even if we suppose a star to be moving with a sufficiently enormous velocity to alter sensibly its color to the eye, no such change would actually be seen, for the reason that the store of invisible light beyond both limits of the visible spectrum, the blue and the red, would be drawn upon, and light-waves invisible to us would be exalted or degraded so as to take the place of those raised or lowered in the visible region, and the color of the star would remain unchanged. About eight years later Fizeau pointed [illegible] the individual wave-lengths of which white light is composed. As soon, however, as we had learned to recognize the lines of known substances in the spectra of the heavenly bodies, Doppler's principle became applicable as the basis of a new and most fruitful method of investigation. The measurement of the s[illegible] shift of th[illegible] celestial bodies from their true positions, as shown by the same lines in the spectrum of a terrestrial substance, gives to us the means of ascertaining directly in miles per second the speed of approach or of recession of the heavenly body from which the light has come.

An account of the first application of this method of research to the stars, which was made in my observatory in 1868, was given by Sir Gabriel Stokes from this chair at the meeting at Exeter in 1869. The stellar motions determined by me were shortly after confirmed by Professor Vogel in the case of Sirius, and in the case of other stars by Mr. Christie, now astronomer-royal, at Greenwich; but, necessarily, in consequence of the inadequacy of the instruments then in use for so delicate an inquiry, the amounts of these motions were but approximate.

The method was shortly afterwards taken up systematically at Greenwich and at the Rugby Observatory. It is to be greatly regretted that, for some reasons, the results have not been sufficiently accordant and accurate for a research of such exceptional delicacy. On this account probably, as well as that the spectroscope at that early time had scarcely become a familiar instrument in the observatory, astronomers were slow in availing themselves of this new and remarkable power of investigation. That this comparative neglect of so truly wonderful a method of ascertaining what was otherwise outside our powers of observation has greatly retarded the progress of astronomy during the last fifteen years, is but too clearly shown by the brilliant results which within the last couple of years have followed fast upon the recent masterly application of this method by photography at Potsdam, and by eye with the needful accuracy at the Lick Observatory. At last this use of the spectroscope has taken its true place as one of the most potent methods of astronomical research. It gives us the motions of approach and of recession, not in angular measures, which depend for their translation into actual velocities upon separate determinations of parallactic displacements, but at once in terrestrial units of distance.

This method of work will doubtless be very prominent in the astronomy of the near future, and to it probably we shall have to look for the more important discoveries in sidereal astronomy which will be made during the coming century.

In his recent application of photography to this method of determining celestial motions, Professor Vogel, assisted by Dr. Scheiner, considering the importance of obtaining the spectrum of as many stars as possible on an extended scale without an exposure inconveniently long, wisely determined to limit the part of the spectrum on the plate to the region for which the ordinary silver-bromide gelatine plates are most sensitive,— namely, to a small distance on each side of

[1] Inaugural address at the meeting of the British Association for the Advancement of Science, at Cardiff, August, 1891, by William Huggins, president of the association (Nature, Aug. 20).

G,— and to employ as the line of comparison the hydrogen line near G, and recently also certain lines of iron. The most minute and complete mechanical arrangements were provided for the purpose of securing the absolute rigidity of the comparison spectrum relatively to that of the star, and for permitting temperature adjustments and other necessary ones to be made.

The perfection of these spectra is shown by the large number of lines, no fewer than 250 in the case of Capella, within [illegible] spectrum on the plate. Already the [illegible] stars have been measured with an ac- [illegible] In the case of a large number of them, of about an English mile per second.

At the Lick Observatory it has been shown that observa- [illegible] made directly by [illegible] h an accuracy equally great. Mr. Keeler's brilliant success has followed in great measure from the use of the [illegible] and fourth spectra of a grating [illegible] lines to the inch. The marvellous accuracy attainable in his hands on a suitable star is shown by observations on three nights of the star Arcturus, the largest divergence of his measures being not greater than six-tenths of a mile per second, while the mean of the three nights' work agreed with the mean of five photographic determinations of the same star at Potsdam to within one-tenth of an English mile. These are determinations of the motions of a sun so stupendously remote that even the method of parallax practically fails to fathom the depth of intervening space, and by means of light-waves which have been, according to Elkin's nominal parallax, nearly two hundred years upon their journey.

Mr. Keeler, with his magnificent means, has accomplished a task which I attempted in vain in 1874, with the comparatively poor appliances at my disposal, of measuring the motions in the line of sight of some of the planetary nebulæ. As the stars have considerable motions in space, it was to be expected that nebulæ should possess similar motions, for the stellar motions must have belonged to the nebulæ out of which they have been evolved. My instrumental means, limiting my power of detection to motions greater than twenty-five miles per second, were insufficient. Mr. Keeler has found, in the examination of ten nebulæ, motions varying from two miles to twenty-seven miles, with one exceptional motion of nearly forty miles.

For the nebula of Orion, Mr. Keeler finds a motion of recession of about ten miles a second. Now this motion agrees closely with what it should appear to have from the drift of the solar system itself, so far as it has been possible at present to ascertain the probable velocity of the sun in space. This grand nebula, of vast extent and of extreme tenuity, is probably more nearly at rest relatively to the stars of our system than any other celestial object we know; still it would seem more likely that even here we have some motion, small though it may be, than that the motions of the matter of which it is formed were so absolutely balanced as to leave this nebula in the unique position of absolute immobility in the midst of whirling and drifting suns and systems of suns.

The spectroscopic method of determining celestial motions in the line of sight has recently become fruitful in a new but not altogether unforeseen direction, for it has, so to speak, given us a separating power far beyond that of any telescope the glass-maker and the optician could construct, and so enabled us to penetrate into mysteries hidden in stars apparently single, and altogether unsuspected of being binary systems. The spectroscope has not simply added to the list of the known binary stars, but has given to us for the first time a knowledge of a new class of stellar systems, in which the components are in some cases of nearly equal magnitude, and in close proximity, and are revolving with velocities greatly exceeding the planetary velocities of our system.

The K line in the photographs of Mizar, taken at the Harvard College Observatory, was found to be double at intervals of fifty-two days. The spectrum was therefore not due to a single source of light, but to the combined effect of two stars moving periodically in opposite directions in the line of sight. It is obvious that if two stars revolve round their common centre of gravity in a plane not perpendicular to the line of sight, all the lines in a spectrum common to the two stars will appear alternately single or double.

In the case of Mizar and the other stars to be mentioned, the spectroscopic observations are not as yet extended enough to furnish more than an approximate determination of the elements of their orbits.

Mizar especially, on account of its relatively long period, — about 105 days,— needs further observations. The two stars are moving each with a velocity of about fifty miles a second, probably in elliptical orbits, and are about a hundred and forty-three millions of miles apart. The stars, of about equal brightness, have together a mass about forty times as great as that of our sun.

A similar doubling of the lines showed itself in the Harvard photographs of β Aurigæ at the remarkably close interval of almost exactly two days, indicating a period of revolution of about four days. According to Vogel's later observations, each star has a velocity of nearly seventy miles a second, the distance between the stars being little more than seven and a half millions of miles, and the mass of the system 4.7 times that of the sun. The system is approaching us at the speed of about sixteen miles a second.

The telescope could never have revealed to us double stars of this order. In the case of β Aurigæ, combining Vogel's distance with Pritchard's recent determination of the star's parallax, the greatest angular separation of the stars as seen from the earth would be one two-hundredth part of a second of arc, and therefore very far too small for the highest powers of the largest telescopes. If we take the relation of aperture to separating power usually accepted, an object-glass of about eighty feet in diameter would be needed to resolve this binary star. The spectroscope, which takes no note of distance, magnifies, so to speak, this minute angular separation four thousand times; in other words, the doubling of the lines, which is the phenomenon that we have to observe, amounts to the easily measurable quantity of twenty seconds of arc.

There were known, indeed, variable stars of short period, which it had been suggested might be explained on the hypothesis of a dark body revolving about a bright sun in a few days, but this theory was met by the objection that no such systems of closely revolving suns were known to exist.

The Harvard photographs of which we have been speaking were taken with a slitless form of spectroscope, the prisms being placed, as originally by Fraunhofer, before the object-glass of the telescope. This method, though it possesses some advantages, has the serious drawback of not permitting a direct comparison of the star's spectrum with terrestrial spectra. It is obviously unsuited to a variable star like Algol, where one star only is bright, for in such a case there would be no doubling of the lines, but only a small shift to and fro of the lines of the bright star as it moved in its orbit alternately towards and from our system, which would need for its detection the fiducial positions of terrestrial lines compared directly with them.

For such observations the Potsdam spectrograph was well adapted. Professor Vogel found that the bright star of Algol did pulsate backwards and forwards in the visual direction in a period corresponding to the known variation of its light. The explanation which had been suggested for the star's variability, that it was partially eclipsed at regular intervals of 68.8 hours by a dark companion large enough to cut off nearly five-sixths of its light, was therefore the true one. The dark companion, no longer able to hide itself by its obscureness, was brought out into the light of direct observation by means of its gravitational effects.

Seventeen hours before minimum, Algol is receding at the rate of about 24½ miles a second, while seventeen hours after minimum it is found to be approaching with the speed of about 28½ miles. From these data, together with those of the variation of its light, Vogel found, on the assumption that both stars have the same density, that the companion, nearly as large as the sun, but with about one-fourth his mass, revolves with a velocity of about fifty-five miles a second. The bright star, of about twice the size and mass, moves about the common centre of gravity with the speed of about twenty-six miles a second. The system of the two stars, which are about three and a half millions of miles apart, considered as a whole, is approaching us with a velocity of 2.4 miles a second. The great difference in luminosity of the two stars, not less than fifty times, suggests rather that they are in different stages of condensation, and dissimilar in density.

It is obvious that if the orbit of a star with an obscure companion is inclined to the line of sight, the companion will pass above or below the bright star, and produce no variation of its light. Such systems may be numerous in the heavens. In Vogel's photographs, Spica, which is not variable, by a small shifting of its lines reveals a backward and forward periodical pulsation due to orbital motion. As the pair whirl round the common centre of gravity, the bright star is sometimes advancing, at others receding. They revolve in about four days, each star moving with a velocity of about fifty-six miles a second in an orbit probably nearly circular, and possess a combined mass of rather more than two and a half times that of the sun. Taking the most probable value for the star's parallax, the greatest angular separation of the stars would be far too small to be detected with the most powerful telescopes.

If in a close double star the fainter companion is of the white-star type, while the bright star is solar in character, the composite spectrum would be solar with the hydrogen lines unusually strong. Such a spectrum would itself afford some probability of a double origin, and suggest the existence of a companion star.

In the case of a true binary star the orbital motions of the pair would reveal themselves in a small periodical swaying of the hydrogen lines relatively to the solar ones.

Professor Pickering considers that his photographs show ten stars with composite spectra; of these, five are known to be double. The others are: τ Persei, ζ Aurigæ, δ Sagittarii, 31 Ceti, and β Capricorni. Perhaps β Lyræ should be added to this list.

In his recent classical work on the rotation of the sun, Dunér has not only determined the solar rotation for the equator but for different parallels of latitude up to 75°. The close accordance of his results shows that these observations are sufficiently accurate to be discussed with the variation of the solar rotation for different latitudes which had been determined by the older astronomical methods from the observations of the solar spots.

Though I have already spoken incidentally of the invaluable aid which is furnished by photography in some of the applications of the spectroscope to the heavenly bodies, the new power which modern photography has put into the hands of the astronomer is so great, and has led already, within the last few years, to new acquisitions of knowledge of such vast importance, that it is fitting that a few sentences should be specially devoted to this subject.

Photography is no new discovery, being about half a century old: it may excite surprise, and indeed possibly suggest some apathy on the part of astronomers, that though the suggestion of the application of photography to the heavenly bodies dates from the memorable occasion when, in 1839, Arago, announcing to the Académie des Sciences the great discovery of Niepce and Daguerre, spoke of the possibility of taking pictures of the sun and moon by the new process, yet that it is only within a few years that notable advances in astronomical methods and discovery have been made by its aid.

The explanation is to be found in the comparative unsuitability of the earlier photographic methods for use in the observatory. In justice to the earlier workers in astronomical photography, among whom Bond, De la Rue, J. W. Draper, Rutherfurd, Gould, hold a foremost place, it is needful to state clearly that the recent great successes in astronomical photography are not due to greater skill, nor, to any great extent, to superior instruments, but to the very great advantages which the modern gelatine dry plate possesses for use in the observatory over the methods of Daguerre, and even over the wet collodion film on glass, which, though a great advance on the silver plate, went but a little way towards putting into the hands of the astronomer a photographic surface adapted fully to his wants.

The modern siver-bromide gelatine plate, except for its grained texture, meets the needs of the astronomer at all points. It possesses extreme sensitiveness; it is always ready for use; it can be placed in any position; it can be exposed for hours; lastly, it does not need immediate development, and for this reason can be exposed again to the same object on succeeding nights, so as to make up by several instalments, as the weather may permit, the total time of exposure which is deemed necessary.

Without the assistance of photography, however greatly the resources of genius might overcome the optical and mechanical difficulties of constructing large telescopes, the astronomer would have to depend in the last resource upon his eye. Now we cannot by the force of continued looking bring into view an object too feebly luminous to be seen at the first and keenest moment of vision. But the feeble light which falls upon the plate is not lost, but is taken in and stored up continuously. Each hour the plate gathers up 3,600 times the light-energy which it received during the first second. It is by this power of accumulation that the photographic plate may be said to increase, almost without limit, though not in separating power, the optical means at the disposal of the astronomer for the discovery of the observation of faint objects.

Two principal directions may be pointed out in which photography is of great service to the astronomer. It enables him within the comparatively short time of a single exposure to secure permanently with great exactness the relative positions of hundreds or even of thousands of stars, or the minutest features of nebulæ or other objects, or the phenomena of a passing eclipse, a task which by means of the eye and hand could only be accomplished, if done at all, after a very great expenditure of time and labor. Photography puts it in the power of the astronomer to accomplish in the short span of his own life, and so enter into their fruition, great works which otherwise must have been passed on by him as a heritage of labor to succeeding generations.

The second great service which photography renders is not simply an aid to the powers the astronomer already possesses. On the contrary, the plate, by recording light-waves which are both too small and too large to excite vision in the eye, brings him into a new region of knowledge, such as the infra-red and the ultra-violet parts of the spectrum, which must have remained forever unknown but for artificial help.

The present year will be memorable in astronomical history for the practical beginning of the photographic chart and catalogue of the heavens, which took their origin in an international conference which met in Paris in 1887, by the invitation of M. l'Amiral Mouchez, director of the Paris Observatory.

The richness in stars down to the ninth magnitude of the photographs of the comet of 1882 taken at the Cape Observatory under the superintendence of Dr. Gill, and the remarkable star charts of the Brothers Henry which followed two years later, astonished the astronomical world. The great excellence of these photographs, which was due mainly to the superiority of the gelatine plate, suggested to these astronomers a complete map of the sky, and a little later gave birth in the minds of the Paris astronomers to the grand enterprise of an international chart of the heavens. The actual beginning of the work this year is in no small degree due to the great energy and tact with which the director of the Paris Observatory has conducted the initial steps, through the many delicate and difficult questions which have unavoidably presented themselves in an undertaking which depends upon the harmonious working in common of many nationalities, and of no fewer than eighteen observatories in all parts of the world. The three years since 1887 have not been too long for the detailed organization of this work, which has called for several elaborate preliminary investigations on special points in which our knowledge was insufficient, and which have been ably carried out by Professors Vogel and Bakhuyzen, Dr. Trépied, Dr. Scheiner, Dr. Gill, the astronomer royal, and others. Time also was required for the construction of the new and special instruments.

The decisions of the conference in their final form provide for the construction of a great photographic chart of the heavens with exposures corresponding to forty minutes' exposure at Paris, which it is expected will reach down to stars of about the fourteenth magnitude. As each plate is to be limited to four square degrees, and as each star, to avoid possible errors, is to appear on two plates, over twenty-two thousand photographs will be required. For the more accurate determination of the positions of the stars, a *réseau* with lines at distances of five millimetres apart is to be previously impressed by a faint light upon the plate, so that the image of the *réseau* will appear together with the images of the stars when the plate is developed. This great work will be divided, according to their latitudes, among eighteen observatories provided with similar instruments, though not necessarily constructed by the same maker. Those in the British dominions and at Tacubaya have been constructed by Sir Howard Grubb.

Besides the plates to form the great chart, a second set of plates for a catalogue is to be taken, with a shorter exposure, which will give stars to the eleventh magnitude only. These plates, by a recent decision of the permanent committee, are to be pushed on as actively as possible, though as far as may be practicable plates for the chart are to be taken concurrently. Photographing the plates for the catalogue is but the first step in this work, and only supplies the data for the elaborate measurements which have to be made, which are, however, less laborious than would be required for a similar catalogue without the aid of photography.

Already Dr. Gill has nearly brought to conclusion, with the assistance of Professor Kapteyn, a preliminary photographic survey of the southern heavens.

With an exposure sufficiently long for the faintest stars to impress themselves upon the plate, the accumulating action still goes on for the brighter stars, producing a great enlargement of their images from optical and photographic causes. The question has occupied the attention of many astronomers, whether it is possible to find a law connecting the diameters of these more or less over-exposed images with the relative brightness of the stars themselves. The answer will come out undoubtedly in the affirmative, though at present the empirical formulæ which have been suggested for this purpose differ from each other. Captain Abney proposes to measure the total photographic action, including density as well as size, by the obstruction which the stellar image offers to light

A further question follows as to the relation which the photographic magnitudes of stars bear to those determined by eye. Visual magnitudes are the physiological expression of the eye's integration of that part of the star's light which extends from the red to the blue. Photographic magnitudes represent the plate's integration of another part of the star's light — namely, from a little below where the power of the eye leaves off in the blue to where the light is cut off by the glass, or is greatly reduced by want of proper corrections when a refracting telescope is used. It is obvious that the two records are taken by different methods in dissimilar units of different parts of the star's light. In the case of certain colored stars the photographic brightness is very different from the visual brightness; but in all stars, changes, especially of a temporary character, may occur in the photographic or the visual region, unaccompanied by a similar change in the other part of the spectrum. For these reasons it would seem desirable that the two sets of magnitudes should be tabulated independently, and be regarded as supplementary of each other.

The determination of the distances of the fixed stars from the small apparent shift of their positions when viewed from widely separated positions of the earth in its orbit is one of the most refined operations of the observatory. The great precision with which this minute angular quantity — a fraction of a second only — has to be measured, is so delicate an operation with the ordinary micrometer, though, indeed, it was with this instrument that the classical observations of Sir Robert Ball were made, that a special instrument, in which the measures were made by moving the two halves of a divided object-glass, known as a heliometer, has been pressed into this service, and quite recently, in the skilful hands of Dr. Gill and Dr. Elkin, has largely increased our knowledge in this direction.

It is obvious that photography might be here of great service, if we could rely upon measurements of photographs of the same stars taken at suitable intervals of time. Professor Pritchard, to whom is due the honor of having opened this new path, aided by his assistants, has proved by elaborate investigations that measures for parallax may be safely made upon photographic plates, with, of course, the advantages of leisure and repetition; and he has already by this method determined the parallax for twenty-one stars with an accuracy not inferior to that of values previously obtained by purely astronomical methods.

The remarkable successes of astronomical photography, which depend upon the plate's power of accumulation of a very feeble light acting continuously through an exposure of several hours, are worthy to be regarded as a new revelation. The first chapter opened when, in 1880, Dr. Henry Draper obtained a picture of the nebula of Orion; but a more important advance was made in 1883, when Dr. Common, by his photographs, brought to our knowledge details and extensions of this nebula hitherto unknown. A further disclosure took place in 1885, when the brothers Henry showed for the first time in great detail the spiral nebulosity issuing from the bright star Maia of the Pleiades, and, shortly afterwards, nebulous streams about the other stars of this group In 1886, Mr. Roberts, by means of a photograph to which three hours' exposure had been given, showed the whole background of this group to be nebulous. In the following year Mr. Roberts more than doubled for us the great extension of the nebular region which surrounds the trapezium in the constellation of Orion. By his photographs of the great nebula in Andromeda he has shown the true significance of the dark canals which had been seen by the eye. They are in reality spaces between successive rings of bright matter, which appeared nearly straight owing to the inclination in which they lie relatively to us. These bright rings surround an undefined central luminous mass. I have already spoken of this photograph.

Some recent photographs by Mr. Russell show that the great rift in the Milky Way in Argus, which to the eye is void of stars, is in reality uniformly covered with them. Also, quite recently, Mr. George Hale has photographed the prominences by means of a grating, making use of the lines H and K.

The heavens are richly but very irregularly inwrought with stars, the brighter stars cluster into well-known groups upon a background formed of an enlacement of streams and convoluted windings and intertwined spirals of fainter stars, which becomes richer and more intricate in the irregularly rifted zone of the Milky Way.

We, who form part of the emblazonry, can only see the design distorted and confused; here crowded, there scattered, at another place superposed. The groupings due to our position are mixed up with those which are real.

Can we suppose that each luminous point has no relation to the others near it than the accidental neighborship of grains of sand upon the shore, or of particles of the windblown dust of the desert? Surely every star, from Sirius and Vega down to each grain of the light-dust of the Milky Way, has its present place in the heavenly pattern from the slow evolving of its past. We see a system of systems, for the broad features of clusters and streams and spiral windings which mark the general design are reproduced in every part. The whole is in motion, each point shifting its position by miles every second, though from the august magnitude of their distances from us and from each other, it is only by the accumulated movements of years or of generations that some small changes of relative position reveal themselves.

The deciphering of this wonderfully intricate constitution of the heavens will be undoubtedly one of the chief astronomical works of the coming century. The primary task of the sun's motion in space, together with the motions of the brighter stars, has been already put well within our reach by the spectroscopic method of the measurement of star motions in the line of sight.

From other directions information is accumulating: from photographs of clusters and parts of the Milky Way, by Roberts in this country, Barnard at the Lick Observatory, and Russell at Sydney; from the counting of stars, and the detection of their configurations, by Holden and by Backhouse; from the mapping of the Milky Way by eye, at Parsonstown; from photographs of the spectra of stars, by Pickering at Harvard and in Peru; and from the exact portraiture of the heavens in the great international star chart which begins this year.

I have but touched some only of the problems of the newer side of astronomy. There are many others which would claim our attention if time permitted:—the researches of the Earl of Rosse on lunar radiation, and the work on the same subject and on the sun by Langley: observations of lunar heat with an instrument of his own invention by Mr. Boys; and observations of the variation of the moon's heat with its phase by Mr. Frank Very: the discovery of the ultra-violet part of the hydrogen spectrum, not in the laboratory, but from the stars: the confirmation of this spectrum by terrestrial hydrogen in part by H. W. Vogel, and in its all but complete form by Cornu, who found similar series in the ultra-violet spectra of aluminum and thallium: the discovery of a simple formula for the hydrogen series by Balmer: the important question as to the numerical spectral relationship of different substances, especially in connection with their chemical properties; and the further question as to the origin of the harmonic and other relations between the lines and the groupings of lines of spectra (on these points contributions during the past year have been made by Rudolf v. Kövesligethy, Ames, Hartley, Deslandres, Rydberg, Grünwald, Kayse and Runge, Johnstone Stoney, and others): the remarkable employment of interference phenomena by Professor Michelson for the determination of the size, and distribution of light within them, of the images of objects which when viewed in a telescope subtend an angle less than that subtended by the light-wave at a distance equal to the diameter of the objective,— a method applicable not alone to celestial objects, but also to spectral lines, and other questions of molecular physics.

Along the older lines there has not been less activity; by newer methods, by the aid of larger or more accurately constructed methods, by greater refinement of analysis, knowledge has been increased, especially in precision and minute exactness.

Astronomy, the oldest of the sciences, has more than renewed her youth. At no time in the past has she been so bright with unbounded aspirations and hopes. Never were her temples so numerous, nor the crowd of her votaries so great. The British Astronomical Association formed within the year numbers already about six hundred members. Happy is the lot of those who are still on the eastern side of life's meridian!

Already, alas! the original founders of the newer methods are falling out,— Kirchhoff, Angström, D'Arrest, Secchi, Draper, Becquerel,— but their places are more than filled:

the pace of the race is gaining, but the goal is not and never will be in sight.

Since the time of Newton our knowledge of the phenomena of nature has wonderfully increased, but man asks, perhaps more earnestly now than in his days, What is the ultimate reality behind the reality of the perceptions? Are they only the pebbles of the beach with which we have been playing? Does not the ocean of ultimate reality and truth lie beyond?

METEOROLOGICAL NOTES.

FOR many years the United States government has assiduously gathered up the meteorological conditions from many stations scattered far and wide over the surface of our great continent, and having collated the facts sent in to the central office, has deduced therefrom certain forecasts known as probabilities. These forecasts are made out twice per day, and then telegraphed broadcast over the country, to be disseminated among the people as widely as possible for the benefit of their commerce, their agriculture, their shipping, and even their lives. For many years I have been on the "volunteer" roster of the United States Weather Service, and as such have been the recipient of weather telegrams once per day. For several years I went to the trouble and expense to supply the usual flags, and faithfully made the proper display of them (at Fayette, Mo.).

In 1889 I saw in the St. Louis *Republic* a brief notice of a "whistle code" in use at Seymour, Ind., and I determined to introduce the whistle in place of the flags, and for the following considerations: (1) The flags could not be seen to any advantage beyond one mile; (2) in foggy weather or during snow-storms the flags could not be seen at all; (3) the whistle could be heard in any kind of weather and to distances reaching from six to eight miles in all directions, and by using a more powerful whistle the distance could be made greater still.

Accordingly I sent to Indiana and obtained the code in vogue there. It was a combination of short and long blasts, the "shorts" sometimes preceding and in other cases following the "longs." I concluded it would be more systematic to have the longs refer to the weather and come first, and the shorts refer to temperature and come last. The chief advantage in having shorts come last was that any one hearing a prolonged blast of the whistle might be sure that no short ones had preceded and been lost. I therefore adopted the following plan. Shorts refer to the temperature, one short meaning colder (the column in the thermometer gets shorter with cold), and two shorts meaning warmer. Longs refer to the weather, one long meaning fair (clear, or cloudy without precipitation), two longs meaning rain or snow. This much being decided upon, it is easy to blow "fair and warmer," or "snow and colder," or "fair and warmer followed by rain," — in the last the shorts come in the middle to separate the one long (fair) and the two long (rain), — or any other combination necessary. For the announcement of cold waves, three longs; and for frosts in the frosty seasons or for severe storms in summer, four longs, were used at Seymour, Ind., and the same were adopted in my code. In September, 1889, the first signal was blown, being preceded by four short blasts as a warning that the "weather" was about to be blown. From that date to this the people for miles around have been daily warned of the probabilities for the succeeding twenty-four hours, and they have shown much interest in the matter, being willing to put up at the mill, if necessary, a more powerful whistle than the one now employed.

One of our merchants had the code printed on his advertising cards, and they may be seen tacked up in stores or homes, or in the hands of citizens near and far. Many people soon commit the code to memory and have no need for the key. Persons have reported hearing the whistle at the distance of ten miles; but, as a rule, it is not regularly heard beyond five or six miles.

During the summer of 1890 I tried to get some of our railroads to adopt the code, and whistle the weather at intervals of five or six miles as the trains sped through the country. One road replied that they had too much whistling to do already, there were so many crossings along the way. But I still do not see why the weather whistle could not be used instead of the customary two longs and two shorts usually blown at crossings.

In the chief signal officer's report for 1890, p. 235, I am credited with the introduction of the whistle code now in use in many places in the State. In recent circulars sent out by Chief Harrington, I see that the code has been still further modified, the three longs being used to indicate "local rains," and three shorts meaning a "cold wave." As a cold wave comes rather under the head of temperature, it is doubtless more appropriate to include it among the shorts.

I have written thus at length about the whistle code because I think it should be widely introduced, entailing no expense for flags to be whipped out by the wind, and reaching more people than flags can. Moreover, by having the dispatch blown at the same hour every day, it becomes a time signal by which the people can set their clocks and watches. The noon hour is a good one where the morning forecasts can be delivered before twelve o'clock.

For several years, by the courtesy of the government, I was permitted to use a set of maximum and minimum thermometers. But they entailed the necessity of observation and adjustment every day, and this duty bound the observer to be at home or to intrust the instruments to other hands, or to break the continuity of his record. So last May one year ago I purchased a Draper self-recording thermometer, regulated it by comparisons with the standard instruments for several weeks, and then gave up these standard instruments.

For twelve months I replaced the charts week by week, and filed away the "red-lined" ones, with dates, etc., properly filled in the blanks therefor. On the first of July of this year (1891) I began to put those charts through again, using purple ink instead of red in the pen. Comparison of temperatures for 1890 and 1891, day by day, hour by hour, is both easy and interesting. I think I shall change the ink to green, or some other color, and use again another year. It is certainly a great comfort to wind up the clock, put in another chart, refill the pen, once per week (say Monday morning), and then go about one's business or on a journey, perhaps, and to know that there is to be no break in the record though away for days at a time. I would not like to go back to the old method again.

T. BERRY SMITH.

NOTES AND NEWS.

THE Brooklyn Institute announces a series of "Institute Extension Courses," consisting of lectures on astronomy, by Mr. Garrett P. Serviss, president of the department of astronomy. The first course will be on the solar system, embracing "The Sun, Its Distance, Size, Motions, and Gravity;" "The Sun, Its Nature and Constitution;" "The Earth as a Planet;" "Mercury, Venus, and Mars;" "Jupiter, Saturn, Uranus, and Neptune;" "The Satellites of the Planets;" and "Asteroids, Meteors, and Comets." The second of the series will deal with the stellar systems, and will consist of "The Geography of the Heavens;" "The Relation of the Solar System to Surrounding Space;" "The Stars, their Magnitudes, Distances, and Motions;" "The Stars, their Spectra and Constitution: Variable and Multiple Stars;" "Nebulæ and the Evolution of Stars;" and "The Constitution of the Universe." The third or advanced course will include "General Laws that Govern the Universe;" "Gravitation and the Perturbations of Planets;" "Light and its Analysis, — How Used as a Means of Investigation;" "Astronomical Photography;" "Electric and Magnetic Forces and their Application in Astronomy;" and "The Measurement of Time." The series will conclude with a course of three single lectures, on "The History of Astronomy;" "The Great Astronomers;" and "Recent Progress in Astronomical Research." Each of these lectures will be illustrated by lantern photographs. The courses are subject to alteration to meet special requirements. The institute will conduct these courses of lectures on the so-called "university extension" plan, under the title of "Institute Extension Lectures." Each lecture will be preceded by a conference on the subject of the previous lecture. A syllabus of each course of lectures, together with directions for reading and study, will be provided. Those who desire may present themselves for examination at the close of a course, by giving ten days' notice. Certificates will be issued by the institute to those who pass a satisfactory examination.

— According to *Nature*, an interesting experiment has been lately made by M. Chabry of the Société de Biologie, with regard to the pressure which can be produced by electrolytic generation of gas in a closed space. While the highest pressure before realized in this way was 447 atmospheres (Gassiot), M. Chabry has succeeded in getting as high as 1,200; and the experiment was broken off merely because the manometer used got cracked (without explosion). The electrolyzed liquid was a twenty-five per cent soda solution. Both electrodes were of iron: one was the hollow sphere in which the gas was collected, the other an inner concentric tube. The current had a strength of one and a half ampères, and was very constant during the experiment, which was merely one preliminary to a research in which very high pressures were desired.

— During the coming winter and spring a course of lectures, under the auspices of the New York Academy of Sciences, will be delivered in Hamilton Hall, Madison Avenue and 49th Street, this city. The lectures will be as follows: Oct. 26, Paraguay, the Land and the People, by Dr. Thomas Morong; Nov. 16, Woman's Part in the Earlier Civilizations, by Professor Otis T. Mason; Dec. 21, Mountains, their Origin and History, by Professor H. L. Fairchild; Jan. 18, The Lochs and Crannogs of Scotland, by Professor Franklin W. Hooper; Feb. 15, Street Scenes in Cairo and Glimpses of the Nile, by Professor H. Carrington Bolton; March 21, Contributions of Organic Chemistry to Modern Medicine, by Professor Arthur H. Elliott; April 18, Elves of the Air, by Dr. A. A. Julien; May 16, Color, by Professor Ogden N. Rood.

— At the twenty-fourth annual meeting of the Kansas Academy of Science, held at Ottawa, Oct. 14, 15, and 16, the following papers were read. "The Evolution of the Human Face," by A. H. Thompson; "Experiments made in 1891 on the Dissemination of the Chinch-Bug Diseases," F. H. Snow; "A New Erythronium (*E. mesochorum*)," by E. B. Knerr; "An Inexpensive Reagent Bottle for Use in Microscopic Work," by E. B. Knerr; "A Partial List of the Plants of Franklin County," by W. E. Castle; "Geographical Distribution of Common Western Plants" and "List of Rocky Mountain Plants collected in 1889," by M. A. Carlton; "On Solanum Rostratum," by L. E Sayre and W. S. Amos; "Is the Rainfall in Kansas increasing?" and "Seven-year Periodicity in Rainfall," by E. C. Murphy; "A Simple Method for the Determination of Equivalent Weights of Metals, as Compared with Hydrogen," E. B. Knerr; "Have Meteorites Magnetic Polarity?" by L. I. Blake; "A Revised List of Kansas Minerals," by G. H. Failyer and E. H. S. Bailey; "The Effect of Scientific Studies upon the Imagination," by Olin Templin; "Restoration of Pteranodon," by S. W. Williston; "Notes on Some New Kansas Cephalopods," by Robert Hay; "Some Statistics Relative to the Health of College Women," by Gertrude Crotty; "List of Diptera, Collected by F. H. Snow at Manitou Park, Col., August, 1891," by F. H. Snow and W. A. Snow; "New Western Diptera," by W. A. Snow; "Characteristic Flora" (second paper), "Some Prairie Plants of Eastern Colorado," and "Variations in Dominant Species of Plants," by M. A. Carlton;" "Doniphan Lake, formation of, in 1891," by E. B. Knerr; "Contributions to a List of Kansas Hymenoptera," by E. A. Popenoe; "On the Therapeutic Value of Some Recently Introduced Chemicals," by L. E. Sayre; "An Astronomical Lantern," by E. B. Knerr; "On the Corrosive Action of Fruit Juices on Tin Cans," by E. H. S. Bailey and E. C. Franklin; "Selective Absorption in Leaves," by A. G. Mayer; "Probable Temperature of Summer at Lawrence, Kan.," by E. C. Murphy; "Nesting of the Pied-billed Grebe" and "Two Rare Birds of Kansas, the White-faced Glossy Ibis, and Clark's Nutcracker," by A. M. Collett.

— The correspondent of the London *Times* at Alexandria, Egypt, states that three colossal statues, ten feet high, of rose granite, have just been found at Aboukir, a few feet below the surface. The discovery was made from indications furnished to the government by a local investigator, Daninos Pasha. The first two represent in one group Rameses II. and Queen Hentmara seated on the same throne. This is unique among Egyptian statues. The third statue represents Rameses standing upright in military attire, a sceptre in his hand and a crown upon his head. Both bear hieroglyphic inscriptions, and both have been thrown from their pedestals face downwards. Their site is on the ancient Cape Zephyrium, near the remains of the Temple of Venus at Arsinoe. Relics of the early Christians have been found in the same locality.

— The marine laboratory of biology and zoology, which is to be instituted at Bergen next year, *Nature* states, will be open to any foreign investigators who may desire to study the marine fauna of that part of Scandinavia.

— Professor N. S. Shaler has been appointed Dean of the Lawrence Scientific School of Harvard University, from which position Professor Chapin recently resigned to accept the directorship of Washington University, St. Louis, Mo.

— Professor Traill Green, M.D., LL.D., dean of the Pardee scientific department, and head of the chemical department of Lafayette College, at Easton, Pa., has retired from active service in the institution owing to advanced years. He has been made professor emeritus of the chemical department.

— Among other articles in the November *Magazine of American History* are "One Hundred Years of National Life; the Contrast between 1789 and 1889," by Dr. Patton; "Introduction of the Negro into the United States," by Rev. Dr. Stakely; and "The Historic Games of Old Canada," by Dr. Prosper Bender.

— Of the "Creole Studies," by Professor Hugo Schuchardt of Gratz in Styria, the latest issue is the ninth in the series, and deals with the Malayo-Portuguese medley language of Batavia and Tugu, on the island of Java. His serial is published in the octavo memoirs of the Imperial Academy of Sciences, Vienna, and in view of the rising interest paid to the studies of foreign languages has attracted a good deal of attention. Among the medley languages, Schuchardt has taken up those that originated from the mixture of Romanic languages with those of the negroes, Malays, and other inhabitants of the African, Asiatic, and American coasts. In this line we mention his studies on the Negro-Portuguese of Annabom (West Africa), on the Annamito-French dialect, on the Indo-Portuguese of Mahé and Cannanore, and of other similar dialects of southern India, and on the Negro-Portuguese of Ilha do Principe (Gulf of Guinea). The ninth pamphlet of the series is, like the others, richly illustrated with vocabularies, popular songs, and other texts; the translation being added on the same page, we are enabled to judge more thoroughly upon the degree of mixture that has taken place between the European tongues and the native dialects.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

COTTON-SEED MEAL IN THE DAIRY RATION.

IN bulletin No. 14 of the Texas Experiment Station is reported a series of experiments made to determine the influence of cotton-seed meal in the dairy ration on the creaming of milk, both by the common or gravity method and the centrifugal method.

In these experiments, cows were tested in lots containing several cows each, the cows in the contrasted lots being in as uniform a condition with respect to milk-flow, time from calving, etc., as it was possible to arrange them. The feed for each pair of contrasted lots was the same, except that one lot received equal parts of corn-meal and bran as bye food, while the other lot had cotton-seed meal and bran in equal parts.

In the case of two lots of five cows each that were far advanced in milk (100 to 124 days on the average) it was found that where the cream was raised by gravity at the ordinary summer temperature, the milk being set at about 70° in Fairlamb cans and skimmed when sour (in twelve to twenty-four hours), an average of 18.4 pounds of butter was lost in the skim-milk of the cows fed on cotton-seed meal for every hundred pounds present in the milk set, as againt 30.9 pounds lost when no cotton-seed or cotton-seed meal was fed.

In the case of two lots of four cows each, less advanced in milk (88 to 93 days) the loss of butter-fat in the skim milk on the cotton-seed meal ration was 22.7 pounds out of every hundred pounds actually present in the original milk, against 31.8 pounds lost when no cotton-seed meal was used.

In the case of two lots of three cows each that averaged but fifty days from calving at the beginning of the test, the loss was 11.3 pounds on cotton-seed meal ration, against 14.9 pounds when no cotton-seed was fed.

The average loss on cotton-seed meal for ordinary setting was therefore 17.5 pounds out of every hundred pounds present in the original milk, against 25.8 pounds lost when no cotton-seed meal was fed.

Where the milk of five cows, a hundred and fifty-two days from calving, was set at a temperature of 45°, and kept at this temperature with ice for twenty-four hours and then skimmed, the loss was 37.6 pounds out of every hundred pounds in the original milk, the cows having no cotton-seed meal; while five cows a hundred and thirty-two days from calving and having cotton-seed meal, lost but 22.9 pounds out of every hundred. When the milk was kept only twelve hours before skimming, the loss without cotton-seed meal was 49.1 pounds, against 31.7 pounds lost with cotton-seed meal, showing a decided advantage in the longer setting.

When the cream was extracted by the centrifugal method as soon as milked, that from four cows, two hundred and ten days from calving, showed a loss of but 1.8 pounds without cotton-seed, and that from four cows, two hundred and eleven days from calving, but 2.3 pounds with cotton-seed meal. That from four cows, sixty-two days from calving, and having no cotton-seed, lost 3.27 pounds, and that from four cows, fifty-eight days from calving, and having cotton seed, lost 3.3 pounds out of every hundred actually present in the whole milk.

These results show that in the case of centrifugal creaming, a very much larger per cent of the butter-fat present in the milk is obtained, and that without regard to the character of the feed used, whereas in ordinary gravity creaming the character of the food may have a very marked influence upon the quantity of butter obtained from the milk.

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.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Throwing-Sticks.

IN the report of the National Museum for 1884 I published a short paper on the "throwing-sticks" of the Eskimo in the Department of Ethnology. The object of this article was to show how the methods and problems of natural history are applicable to the products and apparatus of human industry. Here we had a homogeneous people in blood and language, occupying a zoological area which we call hyperborean, and stretching out to cover Labrador, Greenland, all Arctic Canada, and the shores of Alaska from the Mackenzie district all round to Mt. St. Elias. It was with genuine pleasure that I afterward received from Dr. Seler, Mr. Murdoch, Dr. Stolpe, Dr. Uhle, Mr. Bahnson, Mrs. Nuttall, and Dr. Mortillet their own later contributions upon the same ingenious implement, with the acknowledgements that their publication was stimulated by the Eskimo paper. (Altmexikanische Wurfbretter, von Dr. Ed. Seler, Internationales Archiv für Ethnographie, Bd. iii., 1890; The History of the "Throwing-stick" which drifted from Alaska to Greenland, by John Murdoch, Am. Anthropologist, July, 1890; Ueber Altmexikanische und südamerikanische Wurfbretter, von Dr. Hjalmar Stolpe, in Stockholm, Internat. Archiv f. Ethnog., Bd. iii., 1890; Ueber die Wurfholzer der Indianer Amerikas, von Dr. Max Uhle, Mittheil. der Anthrop. Gesellsch., in Wien, Bd. xvii., n.f. vii., 1887; Ueber südamerikanische Wurfholzer im Kopenhagener Museum, von Kristian Bahnson, Internat. Archiv f. Ethnog., ii., 1889; Mrs. Zelia Nuttall, in a paper read before the Woman's Anthropological Society in Washington, entitled The Atlatl or Spear-Thrower of the Ancient Mexicans, Arch. and Ethnol. Papers of the Peabody Museum, i., No. 3; Les Propulseurs a crochet Modernes et Prehistoriques, Part A., drien de Mortillet, Rev. Mensuelle de l'Ecole d'Anthropologie de Paris, i., 15 Aout, 1891.)

In plate xvii. of my paper two very interesting old specimens are described from the Tlingit or Koloschanaua about Sitka. One of these is figured in Ensign Niblack's monograph (Smithsonian Report, Part II., 1888, plate xxvii, fig. 157). These specimens are very old, are covered with totemic devices, and represent a decayed art passed into its mythic stage. I do not now know of any similar device for throwing spears or harpoons until we get to Mexico, where, as is well shown in the works above quoted, the altatl was one of the commonest weapons. Imagine my great pleasure, therefore, on receiving from Lake Patzcuaro, in Mexico, a modern altatl, well-worn and old looking, accompanied with a gig for killing ducks. The apparatus was bought from the hunter by Capt. John G. Bourke, U.S.A., and may now be seen in the National Museum. The thrower is two feet three inches long, and has two finger-holes projecting, one from the right and one from the left side. In my paper on the Eskimo stick no case of two finger-holes occurs, and the only example in which it projects from the side at all is from Point Barrow. Since the publication, however, another specimen comes from Cerles inlet, and this is quite puzzling. In Dr. Stolpe's paper you have my Patzcuaro specimen exactly, only mine has no ornament and is a practical every-day implement for killing ducks. The spear-shaft is ten feet long, of slender cane, and has a hole at the after end for the hook of the throwing stick. The gig consists of three iron barbs, for all the world like the Eskimo trident for water-fowl. The problem now is to connect Alaska with Patzcuaro.

O. T. MASON.

Washington, D.C., Oct. 26.

Molecular Motion in the Development of Water Waves.

WHEN waves are developed on the surface of water, whether by something thrown into or moving through the water, or by the friction of the wind blowing along the surface, the water constituting the wave rises up and sinks down, but does not move along the surface. When the friction of the wind is the cause of wave production, or when the waves are produced by any other force exerting a pull or a push in the water, there is some horizontal movement or current; but this current is not wave-motion proper, and is entirely distinct from it. The undulations in a slack rope, vibrated at one end, are true wave-motion, analogous to that which occurs on the surface of water.

If we suppose the water to consist of molecules, each having capacity for its own proper motion, and subject to the force exerted by the earth's attraction and by the pressure of other molecules above it, but free to move with comparatively small friction, the formation of waves becomes very simple. Water under the pressure when the formation of waves is possible, is incompressible, and when a solid body is thrown into or moved through the water so rapidly that the displaced particles cannot get out of the way laterally, some of them are forced up, under the well-known law that motion is in the direction of least resistance. If the body is placed in or drawn through the water slowly enough for the displaced particles to push their way horizontally, none of them are thrown up, and the initial wave is not formed. But time is required for this movement, and when the body is thrown into the water, or moved through it rapidly, the displaced particles are forced to rise up against the force of gravitation, the quantity forced up — that is, the size of the initial wave — being determined by the volume of the body and the rapidity of its movement through the water. If the force is impulsive and not constantly acting, the second wave is less than the first, and they go on diminishing until the force is expended in horizontal motion, and there is an elevation of the surface commensurate with the volume of the immersed body, — the same result precisely that would have been reached without wave-formation if the body had been immersed slowly enough.

When wind first impinges against the surface of still water, the friction pulls up a little of the water in the form of a minute initial wave, but the force being constantly acting, the wave continues to increase in size until the maximum possible from the given friction is reached.

The force of cohesion between the molecules of water is less than the pull of gravitation upon them, for if this were not the case, water would stand up like a solid mass, as ice does, instead of spreading out and flowing, in obedience to the force of gravitation, and continuing to flow until it reaches some substance in which the force of cohesion is sufficient to counteract the pull of gravitation on its molecules, or until the increased cohesion from congelation accomplishes the same result.

While the force of cohesion between the molecules of water is not sufficient to prevent them from moving in obedience to the force of gravitation, it is still considerable, and very great as compared with the force of cohesion between the molecules of air and other gases; and when a portion of the water is forced up against the force of gravitation, the substance continues in mass, and must so continue until subjected to a force sufficient to overcome both gravitation and cohesion.

When the mass lifted up in the formation of the initial wave falls back (as it must do under the constantly acting force of gravitation), with a velocity too great to be expended in horizontal motion, the molecules receiving this impact must rise up as those did which constituted the initial wave, and so on, each wave being the progenitor of that wave which follows it. If the force is impulsive, as when a body is thrown into the water, each wave is the sole progenitor of the wave following; if the force is constantly acting, like the friction of the wind, each wave in producing another is supplemented by the constantly acting force which caused the initial wave.

When the uplifted water falls back on something not so free to move as the molecules of water, — as, for instance, when the water becomes so shallow that the fall is against the bottom, or so thick with grass and water-plants as to impede the free movement of the water, — the wave-formation at once begins to diminish and soon ceases entirely. In short, the waves on the surface of the water are the result of the impact of the lifted-up mass falling back on the free to-move molecules constituting the whole mass with a velocity so great that the force cannot be transmitted horizontally.

In observing the phenomenon on a lake a few miles wide, it is interesting to note that, even in a high wind, the surface of the water near the windward shore is only a little agitated by small ripples; farther out it becomes rougher, and on the lee shore the waves have reached the highest point possible for the extent of surface and force of the wind. The pressure of the wind on the surface of an inland lake is constantly variable, even over comparatively small areas, as every one has observed who has navigated a sail-boat; and as the friction, which is the wave producing force, varies with the pressure, the waves vary in both length and height.

When the wind is high the crests of the highest waves become unable to withstand the impact of the force, and are broken into fragments or spray, forming what we call "white-caps." This phenomenon does not depend entirely on the violence of the wind, nor on the height and volume of the waves, but it depends on the relation between these two. If the waves are very large and oval (and this depends on the nature and action of the force producing them), only the most violent wind can cause white-caps, while if the waves are small but narrow and sharp, a comparatively light wind will develop them. In a portion of the water broken up in the formation of white caps, not unfrequently the force of cohesion is so far counteracted that the water is carried off in the form of spray; the residue of the white-cap not carried off as spray, instead of sinking down with the main body of the wave as in other cases, flows down the farther side of it. Hence the formation of white-caps tends to diminish rather than to increase the size of the waves.

It sometimes happens that the impact of the wind against the water elevated above the surface becomes so violent that it is all blown away as spray, and no waves are formed at all. In January, 1884, I think it was, this phenomenon occurred on Lake Eustis, in Florida. We took passage on the "Mayflower," a little side-wheel steamer of from thirty to forty tons burden, very narrow and long, and low decked, to cross the lake from east to west, the distance being about seven miles. It was blowing a breeze from the west, which caused waves probably a foot high, and sufficient to cause the little steamer to rock perceptibly. A very black cloud came up from the west, meeting us, and between one and two o'clock in the afternoon, when we were about one-fourth of the way across, a storm of wind and rain burst upon us with intense fury. Putting on my overcoat hastily, I at once made my way with difficulty through the wind and rain to the pilot-house, a little coop perched on the front end of the deck, to see that the captain, who was steering, did not lose his presence of mind, and to urge him to hold the head of the boat to the wind, from whatever direction it might come. Finding him cool and self-possessed, I returned to the cabin, another little coop amidships, and found the passengers, eight or ten in number, in great terror. Acting on a suggestion of the captain, I got out the life-preservers, and in less time than it takes me now to write this sentence, each passenger had on one, ready for the plunge which we all knew would come in a few seconds if the wind struck the boat on the side. When the life-preservers were put on, I opened my satchel and slipped my travelling flask into my overcoat pocket, leaving money and other valuables to their fate, and took position with my wife, who was one of the party, on the deck (a portion of which in rear of the little cabin was sheltered), so as not to be carried down by the boat if it capsized, and held on to a post to prevent being blown overboard. After these precautions were taken, I looked out on the lake, and to my unbounded astonishment the surface was almost perfectly smooth. The moment an incipient wave would rise above the level, the whole of it was carried away as spray by the wind. I saw this occur repeatedly. The spray and rain made it so dark that only the surface of the lake a few feet from the boat could be seen, but as far as could be seen there was violent agitation but no waves, and there was no more rocking of the boat than in a dead calm. This continued for some time, probably an hour after my first observation, when the storm abated, the clouds passed away, and the sun came out; but the wind was still blowing a stiff gale from the same direction, and soon waves from two to three feet high caused the little steamer to roll and jump more than was pleasant.

So far as I am aware, it has not been ascertained experimentally what determines the coefficient of friction of air moving over the surface of water. It is obviously this friction which causes waves in the water when the wind blows, and, like all other friction, it doubtless depends measurably on the direction and violence of the impact. But the air, by a force the operation of which is not clearly understood, and which we call evaporation, is constantly pulling out molecules of water and absorbing them in aqueous vapor.

The units of energy required to transform a pound of water into vapor is a measurable quantity, and according to the law of conservation of energy, the same units of force must be required to do this work, whether the temperature be 100° C., or 0° C., or anywhere between. The time in which the work can be done varies with the temperature, but the units of force expended must remain the same. If this is so, the force exerted in evaporation is immense, and its direction, apparently, is from the surface of the water upwards. It must therefore necessarily operate as a resistance when the air moves across the surface of the water at right angles to this direction, and thus increase friction.

It seems to be analogous to friction between two solid bodies when one of them absorbs the particles rubbed off from the other; the absorption may not increase the friction, but the rubbing-off does. So in this case, the absorption by the air of the molecules or particles of water as aquous vapor may not increase the friction between the air and the water, but pulling them away from the water certainly ought to do it.

From this it would seem that a dry wind, from its greater capacity to absorb aqueous vapor, ought to produce greater friction and higher waves than a damp wind of the same velocity. This appeared to me to be the case with the winds blowing across Lake Harris at my winter home in Florida. The dry winds following the rain-storm seem to raise higher waves than the damp winds preceding the rain and during its continuance; but without facilities or skill for accurately determining either the relative humidity or the velocity of the wind, such observations are of no value except to call attention to the subject.

There is another view of the matter which seems to me to be worthy of examination. If the evaporation-pull when air passes over the surface of a liquid is an element in the resulting friction and consequent wave development, we have, in the capacity of certain oils to resist evaporation, an explanation of the phenomenon that pouring oil on the surface of water diminishes the waves. This is indicated by the fact that kerosene oil, which evaporates rapidly, does not seem to have the effect of diminishing wave-formation.

Before this probable difference in friction between liquids which evaporate readily and those which resist evaporation had occurred to me I tried the experiment of pouring kerosene oil on the surface of Lake Harris when it was very rough and a high wind blowing. It had no perceptible effect in diminishing the waves, but a conscious want of skill in conducting the experiment left me in doubt as to whether the failure resulted from that or some other cause. Evaporation takes place more rapidly when the air is not moving, because fresh unsaturated portions of the atmosphere are being constantly brought into contact with the liquid surface; and the theoretical probability that this evaporation, this pulling-away of molecules of water by the air into itself, is an element in the friction between the wind and the water, is certainly sufficient to justify the labor of its experimental determination. It may be that the thorough saturation of the wind blowing across Lake Eustis, in the case above mentioned, was itself an element in preventing the wave-formation: the saturation of the wind may have diminished its friction and consequent capacity for wave development, and the blowing away of incipient waves into spray may have increased the saturation. It was obvious that the quantity of water carried off as spray was not at all comparable to that which rises above the level in waves from a wind of less violence. Taking the normal level as the average between the crest and the trough of the waves, there was much more water above that level when the lake became rough after the hurricane had passed, than appeared to be carried off in spray while no waves were being formed.

There is another element of resistance which must be taken into account in determining the friction between wind and water. The air not only absorbs water in the form of aqueous vapor, but the water holds air (or oxygen obtained from it) in solution. This is the air which the fishes breathe, and under atmospheric pressure and near the surface of the water it is estimated that the air thus held in solution constitutes about one-twentieth of the volume of the fluid. This air can be disengaged from the water. It is this disengagement of the air from the water by the suction of a pump, which renders it impossible for a pump to raise ordinary water to the full height to which the atmospheric pressure will raise a column of water from which air is excluded: when the suction of the pump exerts a pull on the water with air in solution sufficient to raise it to about twenty-seven feet, the air in the water is disengaged and fills the vacuum chamber, thus stopping the further lifting of the water by the vacuum pull. This disengagement of the air from the water goes on in water-pipes also. In a system of water-pipes the disengaged air collects in the most elevated portions of the pipes, and, unless discharged through air-valves, becomes a serious obstacle to the flow of the water.

In ice-making, this air in the water is gotten rid of by distilling the water and recondensing it, or by boiling the water and then freezing it before it has re-absorbed air. If the air is not removed in some way, it remains in the ice in small bubbles, rendering the ice white and porous.

It is certain that the agitation of water either impedes or facilitates the absorption of air into solution. The general impression is that agitating the water aerates it, that is, causes it to absorb air; but when water containing odorous vapor is stirred, they are given off. This and some other phenomena seem to me to indicate that agitation, while it enables water to retain in solution matter heavier than itself, has the opposite effect with matter lighter than itself, and that the tendency of agitation is to cause water to release gaseous matter held in solution. But whether the agitation of the water tends to cause it to take air into solution, or to release air absorbed when the water was less agitated, the process, either of absorption or of release, probably increases friction between the wind and the water, as the surface of the water becomes agitated by wave-formation. This element of friction must be very small when compared with the far greater work of evaporation, but it ought to be taken into consideration in determining the difference in friction between air and water and air and oil.

It has been demonstrated, experimentally, that when water evaporates into air as aqueous vapor the process goes on by molecule after molecule, and not by aggregations of molecules or masses; nor that water absorbs oxygen from the air by taking in each molecule separately; but, according to the accepted theory of diffusion of gases, we must assume that the aqueous vapor resulting from evaporation diffuses into the atmosphere by molecules and not by masses; and the fact that the oxygen of the air dissolved in water is separated from the nitrogen, the molecular constitution of the matter absorbed being different from what it was before its solution, leaves no doubt that that process is molecular also: the oxygen and nitrogen molecules, whose intermixture, through diffusion, constitute the atmosphere, are disassociated, the water taking into solution a much larger proportion of the oxygen. This could not possibly occur if the process of solution were not molecular. If the air is composed of the molecules of oxygen and molecules of nitrogen so intermixed as to constitute a continuous substance, a process which takes more of the oxygen than it does of the nitrogen is necessarily molecular.

It seems, therefore, that we are authorized to conclude not only that the waves themselves are the result of motion of the molecules constituting the water, and not of masses of such molecules, but that when wind causes the waves, its friction, in part if not entirely, is due to the passage of molecules from one fluid into the other. DANIEL S. TROY.

Montgomery, Ala, Oct. 23.

Rain-Making.

As Professor Hazen, in his letter published in *Science* of Oct. 16, garbles the quotation from Plutarch which is relied on to prove that the ancients had the same notion in regard to rains following battles that prevails at the present time, I beg leave to give the passage entire, for it is only by a consideration of the whole that his meaning can be arrived at. Plutarch says, in his life of Marius, speaking of the defeat of the Ambrones by the Romans:

' The Romans pursuing, either killed or took prisoners above a hundred thousand. Other historians give a different account of the number of the slain. From these writers we learn that the Massilians walled in their vineyards with the bones they found in the field, and that the rain which fell the winter following, soaking in the moisture of the putrefied bodies, the ground was so enriched by it that it produced the next season a prodigious crop. It is to be observed, indeed, that extraordinary rains generally follow after great battles; whether it be that some deity chooses to wash and purify the earth with water from above, or whether the blood and corruption, by the moist and heavy vapors they emit, thicken the air, which is liable to be altered by the smallest cause."

Now, if we take by itself the statement that "extraordinary rains generally follow after great battles," it would appear, indeed, that the ancient ideas on this subject were identical with those prevailing in modern times. But if we ask the question, "How long after the battles did the rains occur to which Plutarch alluded?" and look for our answer in the context, we shall see, as I said in my letter in *Science* of Oct. 7, that the notions of the former on the subject appear to have been wholly different from those of the latter. When did the rains follow the battle between the Ambrones and the Romans? In the winter following. When did rains follow any other battles that Plutarch had in mind, or when did he think they followed? After the bodies of the dead had putrefied. How soon could the "blood and corruption" — especially the corruption — emit "moist and heavy vapors?" Not under a week. How soon could "some deity wash and purify the earth with water from above?" Not under several months.

It matters not how erroneous Plutarch's ideas were as to why rains followed after battles. It is not his conclusions with which we have to deal, but we are trying to find out what he supposed the facts to be on which he based them. In doing this we have no right to assume as facts anything that is inconsistent with his view of the case.

Professor Hazen quotes the opinion of another rain-maker in opposition to my own. He might also have quoted me against myself. In an article written by me and published in the *Golden Age* of May 11, 1872, and which is also copied into the appendix to the revised edition of "War and the Weather," occurs the following passage:

"If great noises cause rain, some other less expensive way may be devised to produce them. It was noticed, even in ancient times, that great rains followed battles, and it is not impossible that the shouts of a great multitude, with the clashing of metal on metal, may produce the same effect upon the air as the firing of cannon. Should all the inhabitants of a city at a given hour unite in creating an uproar with hands and voices, it would seem to one in our day as though the world were returning to barbarism; but in the higher civilization of some age to come, this may perhaps be a common occurrence."

The other rain-maker referred to has evidently adopted this idea without having made any more critical examination of the passage quoted from Plutarch than I had done when the above was written. But though I have changed my mind in regard to the meaning of this passage, it would be going too far to say that ancient battles did not immediately produce rain, and that the above does not furnish the true explanation of the phenomenon. I only affirm that Plutarch did not say that rains immediately followed great battles, and that the inference that he thought they did cannot be drawn from what he does say. I contend further that, even if the ancients thought that battles produced rain, they may have been wrong, while the moderns may be right in that opinion. Coincidences sometimes occur in thought as well as in action and events.

In speaking of the battles of the late war, and their supposed effect upon the atmosphere, Professor Hazen says, "Mr. Powers thinks that the currents of the atmosphere do not travel at the rate of twenty to fifty miles per hour, or, at least, during these battles they did not do so." This is hardly a fair statement of my position. I think it very probable that portions of two currents moving in nearly opposite directions, in mingling together, lose to a great extent their original motion, and take on a circular motion, moving for a time neither very far east nor very far west. I think that in this way the influence of the concussions may remain in the vicinity of the firing until enough air of different temperatures has mixed together to develop a rain-storm, and that then the storm will move eastward along with the current that supplies the greater portion of the moisture that forms the rain.

Professor Hazen repeats his statement that "one thing seems very certain, that absolutely no rain can be obtained out of a dry atmosphere," and eliminates from it the word "seems." It is not apparent how this helps it as an argument against the artificial-rain theory. According to my understanding of his first article, he did not state this as an abstract idea, but in order to show how unreasonable it was, in his view, to expect to produce rain by concussion in certain states of the atmosphere; and by "atmosphere" I naturally understood him to mean the same thing that he would mean if he were speaking of measuring the humidity of the atmosphere with his instruments. My contention is that there is nothing unreasonable in expecting to produce rain, however dry such air may be, for we are constantly receiving, by the vehicle of air-currents, supplies of aqueous vapor from the tropical portion of the Pacific Ocean; and these currents and the vapor they bring occupy a high altitude, and there the clouds and rain are formed.

Professor Hazen says, "It certainly is not a fact that two currents pass in opposite directions near the point of formation of our storms." How does he know this? He must admit that there is a current moving constantly from west to east or from south-west to north-east. How does he know what there is above this current? Professor Maury gives very strong reasons for believing that there is a polar current there flowing in nearly the opposite direction. Has any one ever given as good reasons for believing to the contrary? Professor Maury's theory was not evolved from a few isolated facts, but from a comprehensive knowledge of the winds throughout the whole world, or so much of it as could be reached by navigators. Has his theory of the circulation of the atmosphere ever been overturned, or even seriously attacked? When I speak of air-currents, one bringing tropical moisture and the other polar cold, I am not drawing upon my own imagination for props to support the theory of artificial rain production, but I am availing myself of the result of investigations and deductions by one who, as a man of science, was a peer to any whom this country has ever produced.

Delavan, Wis., Oct. 19. EDWARD POWERS.

AMONG THE PUBLISHERS.

LOVERS of the camera will read with interest Ellerslie's Wallace's article on "Orthochromatic Films and Plates," in *Outing* for November.

— Some time ago we noticed the first volume of a work entitled "Hermetic Philosophy," and the second volume has now appeared from the press of Lippincott. It purports to be written by "Styx, of the H. B. of L.," and in style and character is a fit companion of its predecessor. It is impossible to give an intelligible idea of the book, for the simple reason that the book itself is not intelligible; but an extract from it will perhaps give our readers some notion of its general character. Speaking of life, the writer says: "A germ of life enters the matrix of its conception as a secondary point in a line of projection, and this line is projected from a paternal fountain of both intelligence and life; and the germ, in order to attain to the freedom of a point, must be stripped of its affiliations with special measurements. When thus liberated, it has simply cast off the physical and resumed its normal psychical habitude. Then in its freedom it may affiliate with the energies which flow in a line, even in those which follow the lunar rays of light; we say in the lunar, because such an entity is yet of a psychical consistency" (p. 86). Elsewhere we read that "we have in us earth, water, air, and fire, which yet are neither earth, water, air, nor fire, nor anything truly" (p. 56); and in our humble opinion this so-called "hermetic philosophy" is neither philosophy, science, nor religion, nor "anything truly."

—"Higher Education in Indiana" is the title of a monograph by Professor James Albert Woodburn of the Indiana University, published by the government Bureau of Education as Circular of Information No. 1, 1891. It contains an outline of the free common school system of Indiana; a brief account of that State's educational history in the development of its common schools; and a historical account of the origin, growth, and development of Indiana's various institutions for higher education, together with a glance at their present condition. The monograph makes a volume of two hundred pages.

— The October number of the *Quarterly Journal of Economics*, which has been delayed for a week or two after its usual date of publication, has made its appearance, with a varied table of contents. Noteworthy among the articles are a paper by Bishop Keane, rector of the Catholic University of America, on the relation of the Catholic Church to the social questions of the day; another by Professor William Carey Jones of California on the Kaweah Co-operative Colony in that State; and one by Professor Bemis of Vanderbilt University on the action of trades-unions with respect to apprentices. Several writers continue the discussion of points of economic theory, and there is a short paper on the Toronto street railway. A note announces a forthcoming reprint of Cantillon's celebrated essay on commerce.

— Professor W. O. Atwater of Wesleyan University contributes an article to the November *Century* on "The Food-Supply of the Future," the first in a series which will have especial value to farmers. The writer believes that the doctrine of Malthus — that the time will come when there will not be food enough for the human race, owing to the theory that population increases in a geometrical and food-supply in an arithmetical ratio — is one which need never give the world any uneasiness, owing to the great advances that are being made in chemistry. Science has shown what are the essential factors in vegetable production, and plants can now be grown in water or in sand by adding the proper chemicals. Professor Atwater gives the result of an interesting experiment recently made in his laboratory. Sea sand was brought from the shore of Long Island Sound. To divest it of every possible material which the plant might use for food except the sand itself, it was carefully washed with water and then heated. It was put into glass jars, water was added, and minute quantities of chemical salts were dissolved in it. Dwarf peas, planted in this sand, grew to a height of eight feet, while peas of the same kind, planted by a skilful gardener in the rich soil of a garden close by, reached a height of only four feet.

— In *Lippincott's Magazine* for November, two articles that will be read with interest are "The Evolution of Money and Finance," by J. Howard Cowperthwait, and "The Restoration of Silver," by John A. Grier. The first is a strong plea for gold only as a standard measure of value. Mr. Grier, from the bi-metallist's point of view, attacks this article, and puts in a plea for the equal use of both gold and silver as a measure of value. The "silver question" is one which every American should understand, and the best way to understand it is to look at both sides of the question.

SCIENCE

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QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19. No response to date.

N. D. C. HODGES,
874 BROADWAY, NEW YORK.

CALENDAR OF SOCIETIES.

Biological Society, Washington.

Oct. 31.—Theodore Gill, The Classification of the Tetraodontoidea; T. H. Bean, Some Fishes New to New England Waters; Walter B. Barrows, Cuckoo Stomachs and their Contents; N. H. Egleston, The Temperature of Trees; C. W. Stiles, Notes on Parasites: Development of Echinorhynchus gigas.

Columbus Horticultural Society, Columbus, O.

Oct. 31.—F. M. Webster, Parasitic Insects; W. A. Kellerman, Parasitic Plants; E. E. Bogue, Autumn Colorations.

SCIENCE

NEW YORK, NOVEMBER 6, 1891.

THE SUN'S MOTION IN SPACE.[1]

SCIENCE needed two thousand years to disentangle the earth's orbital movement from the revolutions of the other planets, and the incomparably more arduous problem of distinguishing the solar share in the confused multitude of stellar displacements first presented itself as possibly tractable little more than a century ago. In the lack for it as yet of a definite solution there is, then, no ground for surprise, but much for satisfaction in the large measure of success attending the strenuous attacks of which it has so often been made the object.

Approximately correct knowledge as to the direction and velocity of the sun's translation is indispensable to a profitable study of sidereal construction; but, apart from some acquaintance with the nature of sidereal construction, it is difficult, if not impossible, of attainment. One, in fact, presupposes the other. To separate a common element of motion from the heterogeneous shiftings upon the sphere of three or four thousand stars is a task practicable only under certain conditions. To begin with, the proper motions investigated must be established with *general* exactitude. The errors inevitably affecting them must be such as pretty nearly, in the total upshot, to neutralize one another. For should they run mainly in one direction, the result will be falsified in a degree enormously disproportionate to their magnitude. The adoption, for instance, of a system of declinations as much as $1''$ of arc astray, might displace to the extent of 10° north or south the point fixed upon as the apex of the sun's way (see L. Boss, Astr. Jour., No. 213). Risks on this score, however, will become less formidable, with the further advance of practical astronomy along a track definable as an asymptote to the curve of ideal perfection.

Besides this obstacle to be overcome, there is another which it will soon be possible to evade. Hitherto, inquiries into the solar movement have been hampered by the necessity for preliminary assumptions of some kind as to the relative distances of classes of stars. But all such assumptions, especially when applied to selected lists, are highly insecure; and any fabric reared upon them must be considered to stand upon treacherous ground. The spectrographic method, however, here fortunately comes into play. "Proper motions" are only angular velocities. They tell nothing as to the value of the perspective element they may be supposed to include, or as to the real rate of going of the bodies they are attributed to, until the size of the sphere upon which they are measured has been otherwise ascertained. But the displacements of lines in stellar spectra give directly the actual velocities relative to the earth of the observed stars. The question of their distances is, therefore, at once eliminated. Now the radial component of stellar motion is mixed up, precisely in the same way as the tangential component, with the solar movement; and since complete knowledge of it, in a sufficient number of cases, is rapidly becoming accessible, while knowledge of tangential velocity must for a long time remain partial or uncertain, the advantage of replacing the discussion of proper motions by that of motions in line of sight is obvious and immediate. And the admirable work carried on at Potsdam during the last three years will soon afford the means of doing so in the first, if only a preliminary investigation of the solar translation based upon measurements of photographed stellar spectra.

The difficulties, then, caused either by inaccuracies in star-catalogues or by ignorance of star-distances, may be overcome; but there is a third, impossible at present to be surmounted, and not without misgiving to be passed by. All inquiries upon the subject of the advance of our system through space start with an hypothesis most unlikely to be true. The method uniformly adopted in them — and no other is available — is to treat the *inherent* motions of the stars (their so-called *motus peculiares*) as pursued indifferently in all directions. The steady drift extricable from them by rules founded upon the science of probabilities is presumed to be solar motion visually transferred to them in proportions varying with their remoteness in space, and their situations on the sphere. If this presumption be in any degree baseless, the result of the inquiry is *pro tanto* falsified. Unless the deviations from the parallactic line of the stellar motions balance one another on the whole, their discussion may easily be as fruitless as that of observations tainted with systematic errors. It is scarcely, however, doubtful that law, and not chance, governs the sidereal revolutions. The point open to question is whether the workings of law may not be so exceedingly intricate as to produce a grand sum total of results which, from the geometrical side, may justifiably be regarded as casual.

The search for evidence of a general plan in the wanderings of the stars over the face of the sky has so far proved fruitless. Local concert can be traced, but no widely-diffused preference for one direction over any other makes itself definitely felt. Some regard, nevertheless, *must* be paid by them to the plane of the Milky Way, since it is altogether incredible that the actual construction of the heavens is without dependence upon the method of their revolutions.

The apparent anomaly vanishes upon the consideration of the profundities of space and time in which the fundamental design of the sidereal universe lies buried. Its composition out of an indefinite number of partial systems is more than probable; but the inconceivable leisureliness with which their mutual relations develop renders the harmony of those relations inappreciable by short-lived terrestrial denizens. "Proper motions," if this be so, are of a subordinate kind; they are indexes simply to the mechanism of particular aggregations, and have no definable connection with the mechanism of the whole. No considerable error may then be involved in treating them, for purposes of calculation, as indifferently directed; and the elicited solar movement may genuinely represent the displacement of our system relative to its more immediate stellar environment. This is perhaps the utmost to be hoped for until sidereal astronomy has reached another stadium of progress, unless, indeed, effect should be given to Clerk Maxwell's suggestion for deriving

[1] A. M. Clerke in Nature of Oct. 15.

the absolute longitude of the solar apex from observations of the eclipses of Jupiter's satellites (Proc. Roy. Soc., vol. xxx. p. 109). But this is far from likely.

In the first place, the revolutions of the Jovian system cannot be predicted with anything like the required accuracy. In the second place, there is no certainty that the postulated phenomena have any real existence. If, however, it be safe to assume that the solar system, cutting its way through space, virtually raises an ethereal counter-current, and if it be further granted that light travels faster with than against such a current, then indeed it becomes speculatively possible, through slight alternate accelerations and retardations of eclipses taking place respectively ahead of and in the wake of the sun, to determine his absolute path in space as projected upon the ecliptic. That is to say, the longitude of the apex could be deduced together with the resolved part of the solar velocity; the latitude of the apex, as well as the component of velocity perpendicular to the plane of the ecliptic, remaining, however, unknown.

The beaten track, meanwhile, has conducted two recent inquiries to results of some interest. The chief aim of each was the detection of systematic peculiarities in the motions of stellar assemblages after the subtraction from them of their common perspective element. By varying the materials and method of analysis, Professor Lewis Boss, director of the Albany Observatory, hopes that corresponding variations in the upshot may betray a significant character. Thus, if stars selected on different principles give notably and consistently different results, the cause of the difference may with some show of reason be supposed to reside in specialities of movement appertaining to the several groups. Professor Boss broke ground in this direction by investigating 284 proper motions, few of which had been similarly employed before (Astr. Jour., No. 213). They were all taken from an equatorial zone 4° 20′ in breadth, with a mean declination of + 3°, observed at Albany for the catalogue of the Astronomische Gesellschaft, and furnished data accordingly for a virtually independent research of a somewhat distinctive kind. It was carried out to three separate conclusions. Setting aside five stars with secular movements ranging above 100″, Professor Boss divided the 279 left available into two sets — one of 135 stars brighter, the other of 144 stars fainter, than the eighth magnitude. The first collection gave for the goal of solar translation a point about 4° north of α Lyræ, in R.A. 280°, Decl. + 43°; the second, one some thirty-seven minutes of time to the west of δ Cygni, in R.A. 286°, Decl. + 45°. For a third and final solution, twenty-six stars moving 40″–100″ were rejected, and the remaining 253 classed in a single series. The upshot of their discussion was to shift the apex of movement to R.A. 289°, Decl. + 51°. So far as the difference from the previous pair of results is capable of interpretation, it would seem to imply a predominant set towards the north-east of the twenty-six swifter motions subsequently dismissed as prejudicial, but in truth the data employed were not accurate enough to warrant so definite an inference. The Albany proper motions, as Professor Boss was careful to explain, depend for the most part upon the right ascensions of Bessel's and Lalande's zones, and are hence subject to large errors. Their study must be regarded as suggestive rather than decisive.

A better quality and a larger quantity of material was disposed of by the latest and perhaps the most laborious investigator of this intricate problem. M. Oscar Stumpe of Bonn (Astr. Nach., Nos. 2999, 3000) took his stars, to the number of 1,054, from various quarters, if chiefly from Auwers's and Argelander's lists, critically testing, however, the movement attributed to each of not less than 16″ a century. This he fixed as the limit of secure determination, unless for stars observed with exceptional constancy and care. His discussion of them is instructive in more ways than one. Adopting (the additional computative burden imposed by it notwithstanding) Schönfeld's modification of Airy's formulæ, he introduced into his equations a fifth unknown quantity expressive of a possible stellar drift in galactic longitude. A negative result was obtained. No symptom came to light of "rotation" in the plane of the Milky Way.

M. Stumpe's intrepid industry was further shown in his disregard of customary "scamping" subterfuges. Expedients for abbreviation vainly spread their allurements; every one of his 2,108 equations was separately and resolutely solved. A more important innovation was his substitution of proper motion for magnitude as a criterion of remoteness. Dividing his stars on this principle into four groups, he obtained an apex for the sun's translation corresponding to each as follows: —

Group.	Number of included stars.	Proper motion.	Apex.			
		″ ″		°		°
I.	551	0.16 to 0.32	R.A.	287.4	Decl.	+ 42
II.	340	0.32 to 0.64	"	279.7	"	40.5
III.	105	0.64 to 1.28	"	287.9	"	32.1
IV.	58	1 28 and upwards	"	285.2	"	30.4

Here, again, we find a marked and progressive descent of the apex towards the equator with the increasing swiftness of the objects serving for its determination, leading to the suspicion that the most northerly may be the most genuine position, because the one least affected by stellar individualities of movement. By nearly all recent investigations, moreover, the solar *point de mire* has been placed considerably further to the east and nearer to the Milky Way than seemed admissible to their predecessors, so that the constellation Lyra may now be said to have a stronger claim than Hercules to include it; and the necessity has almost disappeared for attributing to the solar orbit a high inclination to the medial galactic plane.

From both the Albany and the Bonn discussions, there emerged with singular clearness a highly significant relation. The mean magnitudes of the two groups into which Professor Boss divided his 279 stars, were respectively 6.6 and 8.6, the corresponding mean proper motions 21.9″ and 20.9″. In other words, a set of stars on the whole six times brighter than another set owned a scarcely larger sum-total of apparent displacement. And that this approximate equality of movement really denoted approximate equality of mean distance was made manifest by the further circumstance that the secular journey of the sun proved to subtend nearly the same angle whichever of the groups was made the standpoint for its survey. Indeed, the fainter collection actually gave the larger angle (13.73″ as against 12.39″), and so far an indication that the stars composing it were, on an average, nearer to the earth than the much brighter ones considered apart.

A result similar in character was reached by M. Stumpe. Between the mobility of his star groups and the values derived from them for the angular movement of the sun the conformity proved so close as materially to strengthen the inference that apparent movement measures real distance. The mean brilliancy of his classified stars seemed, on the contrary, quite independent of their mobility. Indeed, its changes tended in an opposite direction. The mean magnitude of the slowest group was 6.0, of the swiftest 6.5, of the intermediate pair 6.7 and 6.1. And these are not isolated facts. Comparisons of the same kind, and leading to identical conclusions, were made by Professor Eastman at Washington in 1889 (Phil. Society Bulletin, vol. xi., p. 143; Proceedings Amer. Association, 1889, p. 71).

What meaning can we attribute to them? Uncritically considered, they seem to assert two things, one reasonable, the other palpably absurd. The first — that the average angular velocity of the stars varies inversely with their distance from ourselves — few will be disposed to doubt; the second — that their average apparent lustre has nothing to do with greater or less remoteness — few will be disposed to admit. But, in order to interpret truly, well-ascertained if unexpected relationships, we must remember that the sensibly moving stars used to determine the solar translation are chosen from a multitude sensibly fixed; and that the proportion of stationary to travelling stars rises rapidly with descent down the scale of magnitude. Hence a mean struck in disregard of the zeros is totally misleading; while the account is no sooner made exhaustive than its anomalous character becomes largely modified. Yet it does not wholly disappear. There is some warrant for it in nature. And its warrant may perhaps consist in a preponderance, among suns endowed with high physical speed, of small, or slightly luminous, over powerfully radiative bodies. Why this should be so, it would be futile, even by conjecture, to attempt to explain.

AN INGENIOUS FORGING PRESS.

MR W. D. ALLEN, in a paper read at the autumn meeting of the Iron and Steel Institute, London, in October (Nature, Oct. 15), described a forging press, which, although it has been at work for some years at the Bessemer Works in Sheffield, is so ingenious, and so new to most people, that it is worthy of description. The press has the appearance of a steam hammer, and, indeed, there is a steam cylinder at the top, just as in a hammer. The use of the steam, however, is only to raise the "tup" when the hydraulic pressure is released. The press consists of an anvil-block below and a ram above, the work being in a vertical direction. The ram works in a hydraulic cylinder, and is carried through the top end of the latter in the shape of a stout shaft or shank, which may be described as a tail-rod to the ram. Attached to this is the piston rod of the steam piston, the latter, of course, working in its own cylinder. The steam cylinder and hydraulic cylinder are therefore placed tandemwise, the latter being underneath. The hydraulic cylinder is supplied with water at pressure by a suitable pump, the barrel of the pump being in direct communication with the hydraulic cylinder, there being no valve of any kind between the two.

If we have made our explanation clear, it will be seen that the ram will descend and ascend stroke for stroke with the pump plunger (the same water flowing backwards and forwards continuously), it being remembered that the steam cylinder has always a tendency to lift the ram. Thus, upon the pump making a forward stroke, the water in its barrel is forced into the hydraulic cylinder; the ram is thus forced down, and gives the necessary squeeze to the work on the anvil. The pump plunger then starts on its return stroke, and so, by enlarging the space in the pump barrel, enables the hydraulic ram to rise and press the water out of the cylinder and back into the pump. The rising of the ram is caused by the lifting action of the steam under the piston; the atter, it will be remembered, being attached to the ram. Of course the water pressure is sufficient to overcome the steam pressure on the downward stroke.

The chief use of this press is to produce work of any given thicknesses within the range of the machine. This end is attained by regulating the volume of water used. The action may be explained as follows. We will suppose, merely for simplicity sake, the contents of the pump barrel to be one cubic foot, and that of the hydraulic cylinder, when the ram is at the full extent of its stroke, to be two cubic feet. We will neglect the connecting pipe between the two, as that is not a variable and does not affect the principle. If there be admitted to the pump but one cubic foot of water as the plunger moves forward, it will drive all this water (omitting clearance) into the hydraulic cylinder, and the ram would therefore only descend one-half its stroke. If the stroke were two feet the travel would be twelve inches, whilst there would be twelve inches of space between the anvil and the lower side of the squeezing tool on the end of the ram. Objects of twelve inches, or above twelve inches in thickness, could therefore be forged. If, however, an article six inches thick had to be worked, another half cubic foot of water would have to be admitted. As the pump barrel would only accommodate one cubic foot of water, the extra half cubic foot would remain permanently in the hydraulic cylinder, and the ram would therefore not go, by six inches, to the top of its stroke; in other words, the traverse of the ram would be carried six inches nearer the anvil.

It will be remembered that the upward movement of the ram is effected by the steam cylinder, which is powerful enough to lift the dead weight of the ram, but is overcome by the hydraulic pressure. It will be seen that by regulating the volume of water in the machine, the ram — although always making the same length of stroke — can be kept working at any given distance from the anvil: the ram and pump-plunger making stroke for stroke as the water flows backwards and forwards between the barrel of the pump and hydraulic cylinder. The device is no less important than ingenious. In ordinary forging, reliance has to be placed for accuracy of work on the skill of the workman. It is surprising how near perfection a good forgeman will arrive by constant practice. Such men are necessarily scarce, and as a consequence very highly paid, but even the nearest approximation of eye and hastily applied callipers, with the chance of getting a little too much work on at the last minute, cannot equal the absolutely correct results of this automatic system.

ASTRONOMICAL NOTES.

The Rev. T. E. Espin has found two new variable stars in Cygnus, viz., D. M. + 36°, 3852, and D. M. + 49°, 3239. They are both of a strong red color.

The Harvard College Observatory has just issued a paper entitled "Preparation and Discussion of the Draper Catalogue." The introduction to the volume contains reference to the gift of Mrs. Draper of the funds by which the work has been carried on, and also a description of the instrument with which the photographs were taken. Then follows a catalogue of the spectra of the stars. The plates were exposed in the years 1886 and 1887.

In the Proceedings of the Irish Academy (vol. 4, No. 4, third series) Mr. J. E. Gore has a very interesting paper entitled "A Catalogue of Binary Stars for which Orbits have been Computed." The catalogue contains 59 stars, giving the name of each star, its approximate position for the epoch 1890.0, the elements, by whom computed, magnitude of components, color of components, their spectra, the "hypothetical parallax,"—for the process of computing reference should be made to Mr. Gore's article,—and the most recent parallax of the star as determined by observation. Mention is also made of the publication in which the elements first appeared. The notes following the catalogue are very complete, and will be found very useful to those interested in this particular branch of astronomy.

In another paper read before the same society, Mr. Gore gives his observations of the variable star μ Cephei. He finds that the variation of light for this star does not exceed half a magnitude, and is very irregular, the star sometimes remains for several months with little or no change in its brightness. Mr. Gore, in a third paper, gives the orbit of the double star 35 ι Comae Berenices. The magnitudes of the components are 5 and 7.8 respectively. He has found for this pair of stars a period of 228.4 years. He has computed the elements, and from this has derived the position angles and distance between the stars from Struve's first measurement in 1829 to Burnham's last measurement, made in 1891. The residuals betweeen the computed and observed position angles are quite small, and with one or two exceptions the computed and observed distances compare very favorably.

EXPERIMENTAL DIPHTHERIA.[1]

PROFESSOR WELCH and Dr. Flexner present a preliminary account of the results of their study of experimental diphtheria in guinea-pigs, rabbits, and kittens. They employed in their experiments pure cultures of the Klebs-Lœffler diphtheritic bacillus, which they inoculated into the trachea and under the skin of these animals. The study which they made was directed particularly to the changes in the tissues produced by these organisms. Previous observers had not confirmed fully the results obtained by Oertel in his study of the alterations in the tissues in human diphtheria, and hence an important factor in the causation of the disease was missing. Drs. Welch and Flexner found that the lesions described by Oertel in human diphtheria are also present in the tissues of animals dead of the experimental disease, and in addition they describe a number of lesions which have not been found up to this time in the disease in human beings. They produced at the seat of inoculation a false membrane, in which the bacilli multiplied. The bacilli remain in the local process; they never invade the blood and tissues of either animal or man, and the general effects are caused, not by the bacilli themselves, but by a poison which they produce.

As in human diphtheria the place of entrance of the poison and the contiguous parts show the greatest destruction, so also in animals the seat of inoculation and the neighboring lymphatic glands exhibit the gravest changes; and, further, as is the case in human diphtheria, distant organs are affected, so is it in the experimental form of the disease. These observers found lesions in the seat of inoculation and adjacent tissues of the most intense nature, in the heart, lungs, liver, kidneys, adrenals, thyroid gland, the epithelium and lymphatic apparatus of the intestinal tract, and in all of the lymphatic glands of the body. The lesions described consist of death of cells, shown by the extensive nuclear fragmentation that has taken place, the affected cells being converted often into a substance resembling fibrin; a hyaline death of cells which occurs in the liver and adrenals especially, and the production of intense fatty degeneration of the muscle of the heart, the epithelium of the kidneys and liver. Hence, a valuable link is added to the chain of evidence that the cause of human diphtheria is a specific organism — the Klebs-Lœffler diphtheritic bacillus.

[1] The Histological Changes in Experimental Diphtheria. Preliminary communication. By William H. Welch, M.D., professor of pathology and Simon Flexner, M.D., fellow in pathology. The Johns Hospital Bulletin, No. 15, August, 1891.

NOTES AND NEWS.

A KIND of artificial honey which has lately been produced seems likely to become a formidable rival of natural honey. It is called "sugar honey," and consists of water, sugar, a small proportion of mineral salts, and a free acid; and the taste and smell resemble those of the genuine article. Herr T. Weigle brought the subject before a recent meeting of the Bavarian Association of the Representatives of Applied Chemistry, and there is a paragraph about it in a recent number of the *Board of Trade Journal.*

— It is stated in *Nature* that a cat born with only two legs (the fore legs being absent from the shoulder-blades) has been recently described by Professor Leon of Jassy (Naturw. Rundsch.). It is healthy, and goes about easily, the body in normal position. When startled, or watching anything, it raises itself to the attitude of a kangaroo, using the tail as a support. This animal has twice borne kittens, in both cases two, one of which had four feet, the other only two.

— Hysteria in men is apparently not rare in other countries, but in England, according to the *British Medical Journal*, it is, relatively speaking, very uncommon. Not many years ago a Russian physician observed that true hysterical fits were common among young Circassian men, and the disease might reasonably be suspected to prevail where men of an imaginative and impressionable stock predominate. Judging by the evidence of French medical publications. Frenchmen are far more subject to hysteria in adult life than Englishmen. Occasionally certain cases recorded in French medical newspapers must cause us to reflect; are such cases hysterical at all, or are certain nervous affections common in England really forms of hysteria? The doctrine that hypochondria is in males the homologue of hysteria, must be accepted by the French on the evidence of what prevails in England. For hypochondria, low spirits, or "spleen," is proverbially common there, and the French hold exaggerated opinions on the subject. In a more excitable race, more acute nervous symptoms might be expected.

— Rats at Aden appear to have a vigorous appetite, and to adopt remarkable ways of gratifying it. Captain R. Light, writing on the subject from Aden to the Journal of the Bombay Natural History Society (from which *Nature* quotes), says the rats in his house — which is overrun with them — demolish skins, braces, whips, etc.; and one night he awoke, feeling a rat gnawing at his toes. This happened in spite of a dog (a good ratter) being in the room. Captain Light was lately watching his pony being shod, and noticed the hoof apparently cut away all round the coronet, wherever it was soft. He accused the "nalband" of doing this in addition to the usual rasping of the hoof to suit the shoe. The "syce" said that the rats had done it, and that they came at night and ate away not only the pony's hoofs but those of the goat and kid, and that these animals were greatly tormented by the rats. Captain Light examined the hoofs, and found beyond doubt that such was the case, the marks of the teeth being plain; moreover, he found that the horns of the kid, which had been about half an inch high, were eaten flush with the head. Next morning, too, a large rat was discovered in the bedding under the horse. It had evidently been killed by a kick from him.

— The mareograph in the harbor of Pola, according to Lieut. Gratzl (Met. Zeitsch.), often shows, in addition to the ordinary tidal curve, certain more or less regular oscillations, generally with a period of about fifteen minutes (some with one of seven minutes). According to *Nature*, these appear to be of the nature of *seiches,* and to be caused by squalls, which drive water from the open sea into the partly inclosed basin of the harbor, where it rises as a wave, retires, rises again to a less height (as only part of the surplus water escapes), and so on. Thus, in the evening of July 6, 1890, after a stiff west-north-west squall, there were eight pronounced oscillations, the strongest showing about 1.4 inches difference of level in sixteen minutes. In another case, the harbor level rose higher than it had done for fifteen years. The latter squall (a strong south-west one) affected also the Trieste mareograph, which showed nine wide oscillations with a mean period of one hour forty-six minutes. Lieut. Gratzl suggests observations as to whether sudden impulses of "bora" against the Italian coast might not heap up the water there, so that a return wave might affect the Austrian mareographs; also whether certain sudden currents which injure fishermen's nets in the Dalmatian canals may not be connected with those waves.

— Last winter there were some reports, says *Nature*, that sunset phenomena had greatly increased in brilliancy, as if something similar to the optical disturbance following the Krakatoa eruption had occurred. Herr Busch has remarked (Met. Zeit.) how difficult it is to recognize gradual variations in such phenomena, or to say where they pass beyond the normal. Even the brown-red Bishop's ring may be regarded as quite normal in winter. A much more sure method of finding an optical disturbance of the atmosphere is measurement of the polarization of light. Herr Busch has carried this on systematically for some years with a Savart polariscope, and a simple instrument for measuring angles, determining the height of the two neutral points (Babinet's and Arago's) at sunset. Now, the values for this height, in February and May last, considerably exceed those obtained in the three previous years, and come near those in 1886, when the last traces of the great atmospheric disturbance were still everywhere perceptible. It would seem, then, that some optical disturbance has been really present, the beginning, extent, and cause of which, however, are in obscurity. The desirability of systematic observations in different places is pointed out.

— For the prevention of sea sickness, a curious notion seems to be common that the stomach should be kept as full as possible. Thus have we seen stout old men and women take with praiseworthy persistence — had the result been satisfactory — biscuits, brandy and soda, apples, a pint of porter, a red herring, and various other edibles and potables, says the *Lancet*, with an entire want of success in retaining them, a course of procedure peculiarly trying to those who happen to be standing, or rather lying, on the verge of the act of vomiting. Were we to counsel those who are liable to this affection, we should recommend as follows. Take a moderate meal two hours before going on board. Remain on deck amidships, well protected against cold, as long as possible. As soon as the premonitory symptoms appear, retire to the berth, undress as quickly as possible, and lie flat on the back for the first twelve or even twenty-four hours without food. Then take a small portion of dry bread and roast beef without fluid; this the stomach will probably retain. If there is much movement of the vessel, lie quiet again, or even go upon deck, and in the course of thirty-six or forty-eight hours the system will have recovered itself, and no further trouble will be experienced. It is a mistake to introduce a quantity of fluid, even of strong coffee, into the flaccid stomach, but if sickness persist, a glass of champagne will probably prove serviceable. In some few persons quinine or antipyrin, chloral or potassium bromide, may act well, but as a rule medicine of all kinds should be eschewed by those who do not wish to aggravate what is already hard to bear.

— Caoutchouc, or india-rubber, is produced in Dutch Guiana under different species, the most important of which is "balata" or "milk of the bullet tree," the export of which, says Consul Wyndham of Paramaribo, is attaining considerable proportions, and will, it is believed, be very productive for a time only, as there is no forest conservancy law in the colony. Persons who are granted tracts of land for the gathering of this product are uncontrolled in their method of drawing the milk, which results in trees being totally destroyed to get the greatest amount of milk by the quickest and most inexpensive method. The district where the largest quantity of balata trees are known to exist in the colony is that bordering on the Correntyne River, known in Dutch Guiana as the "Nickerie district." Balata is treated by the manufacturers simply as a superior kind of gutta-percha, and therefore its name disappears when manufactured; nevertheless balata is distinctly different from gutta-percha, and this is manifested in some of its physical characters; for instance, it is somewhat softer at ordinary temperatures and not so rigid in the cold. Besides the bullet tree, there are trees or plants known as the *Tonckpong*, which give a valuable rubber, and again *Bartaballi* and *Bushrope*, to which collectors do not appear to have given a name. The india-rubber balata industry, although carried on in Dutch Guiana in a desultory way for a long time, has never until quite recently assumed sufficient importance to cause the local government to legislate upon it. As yet the law only lays down the regulations under which concessions are granted, and does not deal with the supervision or treatment of the trees, or the method of extracting the milk. Caoutchouc is yielded both by trees and vines. Those already mentioned are, as far as it is known, the principal ones in the colony, and the method of collecting the milk is by cutting down trees, by incisions, and by circling the tree. In each case there is no protective law, and the trees are generally ruined. The chief port of export is Demerara, and as yet no export duty exists, but as the production increases it is expected that it will not escape taxation. Nothing has been done to cultivate the plant, neither does the soil seem to favor its growth except in some peculiar circumstances.

— The comet found by Professor Barnard of the Lick Observatory on Sept. 27 proves to be the long-looked-for Tempel-Swift comet. It was first discovered by Tempel in 1867, and by Swift in 1880. It was not until the latter date that it was settled that a new short-period comet had been added to the list. Mr. Bossart, one of the computors connected with the Paris Observatory, had computed the perturbations from 1880 to date, and had also prepared an ephemeris. The date of perihelion as determined by Mr. Bossart appears about 2.4 days late. With that correction, the following ephemeris has been computed. The epoch is for Berlin, midnight.

1891.	R. A.		Dec.
	h. m. s.		deg. min.
Oct. 30	21 21 13	+	6 19 8
Nov. 1	26 2		7 3.4
" 3	31 17		7 48.9

The following are the positions for Wolf's comet for the next ten days. The epoch is for Greenwich, midnight.

1891.	R. A.		Dec.
	h. m. s.	—	deg. min.
Nov. 8	4 38 30		5 59.4
" 9	38 1		6 26.1
" 10	37 32		6 52.2
" 11	37 0		7 17.7
" 12	36 28		7 42.7
" 13	35 55		8 6.9
" 14	35 20		8 30.5
" 15	34 45		8 53.4
" 16	34 8		9 15.7
" 17	33 31		9 37.2
" 18	4 32 53		9 58.1

The comet discovered by Professor Barnard on Oct. 3 is passing very rapidly southward, and can only be seen in the southern hemisphere. An ephemeris for following dates is not at hand.

— Dr. Kirkwood, professor of astronomy in the University of Indiana, has been appointed to lecture on astronomy at Stanford University, California.

— The regents of the University of California have elected Dr. Henry Crew, instructor in physics at Haverford College, as an astronomer at the Lick Observatory.

— It is hinted in the October number of the *Observatory* that Dr. Hind, who has been for many years the superintendent of the English Nautical Almanac, will soon retire from that position.

— Professor Asaph Hall, the eminent astronomer, who has been for many years in charge of the large telescope at the United States Naval Observatory, has been placed on the retired list of the navy.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The International Geological Congress in Washington.

THERE have been numerous unofficial accounts of the late Washington meeting of the Geological Congress, but none has yet appeared in which the attendance and work performed have been compared with those features of the previous congresses.

It will be recalled that at the London session of 1888 the American committee was authorized to invite the Congress to meet in America for its next or fifth session. Austria-Hungary had previously had a quasi promise that the fifth session should be held in Vienna, but her representatives at the London session, Mojsisovics and Stur, gracefully and generously yielded to the invitation from America.

From the official minutes of the meeting of the Council on Wednesday, Sept. 19, we learn that M. Frazer presented, on behalf of many scientific societies and of institutions for higher education, the invitation to meet in the United States in 1891. M. von Zittel, Hauchecorne, Stur, Hunt, Capellini, de Lapparent, and Macfarlane warmly seconded this invitation. The former added that the well-known generosity of Americans would make the visit easy. M. Stur said that the Austro-Hungarian geologists very much desired the congress to be held in Vienna, but after having heard the invitation to meet in the United States he would also support this invitation, in the hope that three years later, or in 1894, the congress would come to Vienna, when he promised them a warm reception. M. Neumayr repeated M. Stur's wish, and hoped that the session of 1894 would be reserved for Vienna.

The last act of the president of the congress, Professor Prestwich, was to declare the session closed and adjourned to Philadelphia in 1891.

Three years is none too long to get the endless details for a meeting of this kind arranged, yet over two years were wasted, and less than twelve available months remained in which to secure the participation of societies and geologists throughout the world, to negotiate special rates of transportation on sea and land, to perfect the plans of visits to mines and distant localities, and, above all, to raise money to entertain the foreign guests in a manner which they have been taught to understand is the American manner. The result may be gathered by an inspection of the following table, which gives the attendance of members from foreign countries as well as from the country in which the session was held for each of the five sessions. It should be noted that there are no official statistics giving the number enrolled separately from the number which attended the first or Paris session. The "N" in the first horizontal line below the name of the city indicates natives of the country where the session was held; the "F" stands for foreigners.

	Paris 1878	Bologna 1881	Berlin 1885	London 1888	Washington 1891
	N. 193 F. 107	N. 150 F. 75	N. 166 F. 97	N. 2[illegible] F. [illegible]	N. 148 F. 58
Argentina........	–	–	–	1	–
Australia........	1	–	–	1	–
Austria-Hungary..	5	8	17	10	3
Belgium..........	14	6	6	15	
Bulgaria.........	–	–	–	1	–
Brazil...........	–	–	1	–	–
Chili............	–	–	–	–	1
Canada...........	3	1	1	3	2
Denmark..........	1	1	1	–	–
Egypt............	–	2	–	–	–
France...........	193	18	10	17	5
Germany..........	6	6	166	29	23
Great Britain.....	3	6	12	281	3
Holland..........	3	–	2	1	–
India............	–	1	–	1	–
Italy............	15	150	19	12	–
Mexico...........	1	–	–	2	3
Norway...........	2	–	3	2	1
New Zealand......	–	–	–	1	–
Portugal.........	1	2	1	2	–
Peru.............	–	–	–	–	1
Poland...........	–	3	–	–	–
Roumania.........	9	1	1	2	2
Russia...........	7	6	7	13	8
Sweden...........	6	1	3	4	4
Switzerland......	10	8	3	5	2
Spain............	12	4	1	4	–
United States.....	8	1	9	14	148
Percentage of foreigners..........	35.66	33.33	36.88	34.80	28 15

It appears from the table, which has been compiled from the official reports of the first four sessions, and from the report of the Washington session published in the *American Geologist*, that the last or American session was distinguished, first, for the smallest aggregate attendance of participants; second, for the smallest number of native participants; third, for the smallest number of foreign participants; fourth, for the smallest proportion of foreign to total participants.

How far the American participants represented the geologists of the country it is difficult to say, but of the six who were accredited to Philadelphia, one was a professor of physics in the University of Pennsylvania, one was a physician and mineral dealer, two were young mining and geological engineers, one was an amateur mineralogist, and the sixth was a professor of geology.

But the difference in the character of this from all previous sessions of the International Geological Congress becomes apparent when we examine the lists of the foreign visitors. Of men like

Capellini, Hauchecorne, Beyrich, Renevier, Vilanova, Delgado, de Lapparent, Dewalque, Torell, and a few others who have been the acknowledged leaders and directors of the congress, and most of whom have attended every session, not one was here. In fact, with the exception of Professors Gaudry, von Zittell, T. M. K. Hughes, Dr. Barrois, and perhaps two or three more, there were no geologists of the first rank from abroad at all. Professor Hauchecorne stated three years ago that he intended to bring twenty or thirty mining students from Germany to visit our anthracite regions, yet the writer is informed that after the arrangements for a visit to the anthracite fields had been completed by others than the Washington committee, no one took advantage of the opportunity.

As to the work done, according to the reporter of the *American Geologist*, "the congress passed off with the simple presentation, largely or entirely, of some American views on American geology, followed by such desultory comment or discussion as happened to spring up."

The "long excursions" may have resulted in much good to the visitors. It is to be hoped that they did, for the subscription price was prohibitive for many foreigners who would have been best able to profit by them. PERSIFOR FRAZER.

Philadelphia, Pa., Oct. 27.

The Man of the Future.

A READING of the article under the above heading by Dr. Shufeldt (*Science*, Oct. 16) impresses me with the manifold difficulties attending all speculations regarding the future history of the race, as a result of the varying standpoints occupied by the anthropological prophets.

The problem of human progress seems to have a five-fold aspect, physical, material, social, moral, and intellectual; and it therefore involves questions belonging to sciences as widely divergent as physiology, technology, sociology, and psychology.

Upon its first phase Dr. Shufeldt, as a professional biologist, can speak with much more authority than myself. But there is not wanting excellent biological authority for the supposition that a further natural development in this respect is precluded by the artificial conditions which have made man to a large extent independent of those laws whose operation is traceable in all the history of organic evolution. This, of course, does not militate against the probability of changes tending towards his perfect adaptation to the erect posture and the elimination of rudimentary structures, as resulting from the varying conditions of his artificial environment. Although in the sub-human state the environment may have made the man, in the human state the man, generally speaking, makes his environment. The care taken to preserve the sickly, imbecile, and otherwise useless or noxious members of society, is, from this point of view, a powerful anti-progressive factor. The refinements of civilization place man out of the reach of natural selection, and operate to diminish his vital energy, at the same time they promote delicacy of structure. Such practices as tight-lacing and foot-pressing are barbarous customs, tending truly, as Dr. Shufeldt observes, to produce structural modifications, but certainly doomed to extinction at the very next stage of psychological evolution.

The ruling ethical codes not only give rise to an unscientific tenderness, but they operate to prevent sexual selection. The only serious attempt at scientific human stirpiculture was in the Oneida Community; and this has been a failure, partly because of the inevitable triumph of traditional instincts over speculative principles, as soon as the zeal of the experimenters had cooled, and partly because of symptoms of a violent crusade against the experiment by the exponents of the accepted morality. If the government could follow the suggestion made by Professor Lester F. Ward and other savants, and relegate the whole business of the propagation of the species to individuals especially selected for the purpose, a very rapid improvement would naturally take place; but the plan is fraught with collateral difficulties, and, even if these could be overcome, it seems to be forever out of the question, on account of the moral impossibility of obtaining for it, under any conceivable circumstances, the sanction of public opinion.

Dr. Shufeldt's prediction of the abolition of war is open to the criticism that we have no knowledge of any animal whose existence is not accompanied, if not maintained, by warfare and even deliberate slaughter. Progress has thus far tended, not towards peace, but towards periodicity in war. The engines of destruction become daily more deadly, and each war is more costly, both in men and money, than the preceding. Chateaubriand, in his pamphlet "De Bonaparte et des Bourbons," calculated that more lives had been lost during the Napoleonic wars than during the whole of the Middle Ages throughout all Christendom. An argument in favor of war, considered in the abstract, is that its psychological effects are exceedingly good, and that periods of peace are usually periods of moral degradation.

The material progress of the past century has been unquestionably enormous, and as its continuance seems to be assured for all time, it is difficult to set a limit to its possibilities; but this field is a well-worked one, and predictions are superfluous. It must be observed, however, that the problem of aerial navigation seems on the point of being solved, now that it has passed out of the hands of charlatans into those of serious scientific investigators; and if it once becomes an accomplished fact, it will produce such changes in the conditions of human life as to vitiate any speculations which do not take it into account.

The social progress of the world, or even of Christendom, I venture to believe problematical. The principle of political and social equality seems to be directly in the teeth of modern science, which assures us, above all things else, that inequality is not merely an existing fact throughout the whole domain of nature, but that it is the *sine quâ non* of progress. Every new type is created by the accumulation of variations in the old. The differentiation of the patrician classes from the plebian is a continuation of the same process which, according to the evolutionary hypothesis, has differentiated from each other all the diverse forms of animal and vegetable life. The tendency in modern society to obliterate hereditary distinctions is detrimental to progress, for so far as it is carried out it makes impossible the production of any higher human type than the present.

Furthermore, the laws of nature are uniform throughout all realms, and that of specialization of function holds good in sociology as well as in biology. The highest social condition would be one in which every social, industrial, and political function was performed by a distinct class, concentrating upon that function all its energies. It is this principle which alone makes the man structurally superior to the *Amoeba*; and the popular negation of it is an indication that the tide of social development is in its ebb.

This negation is not usually extended to the industrial realm, where specialization of function is the order of the day. But this industrial progress has given rise to grave problems, which cannot be solved in a half-hour.

It is when we come to the psychological aspect of progress that we are confronted with the most serious difficulties, for upon no point is there a greater variance of opinion in the thinking world than upon the lines which true moral, religious, and intellectual progress must follow.

It is even a debatable question whether there can be any moral or religious progress, as it is denied that ethics or religion have any other than a pathological significance. To give them validity, there must be a real object and true mode of worship, and an imperative norm of duty. It would seem, on the one hand, that it is impossible to verify or vindicate scientifically these fundamental postulates; and yet both religion and ethics are so characteristic of the human species as to lead to the suspicion of a psychological atavism wherever they are absent.

Passing by this antinomy, it is evident that if there are any religious and ethical facts, they must be capable of definition, classification, and rational exploitation: in other words, a science may be erected upon them, and a progress in this science must take place parallel to that which every other science is undergoing.

The question of intellectual progress in general is as difficult as that of religion and morals. Such a progress may take two forms; either the accumulation of knowledge, or the development of the faculties of thought and observation. As regards the first, no one can doubt that the stock of knowledge possessed by the human race at large is rapidly increasing, and will continue to do so. But in the second we meet with several difficulties. If, as Dr. Paul Carus says, metaphysics is "a disease of philosophy" and devoid of value, its decreased influence in the world of thought would seem to indicate a progress of the human mind in the direction of healthy and fruitful activities. But the fact that all science presupposes certain metaphysical concepts,— as that of the trustworthiness of the instinct which attributes objectivity to phenomena cognized by the senses,— would seem to belie the dictum of the great monist; and, as the abstract notions of metaphysics are much farther removed from sub-human psychological conditions than are the concrete ones of natural science, the disuse of metaphysics would appear from an evolutionary standpoint to be, like the atrophy of the religious sense, an indication of retrograde development. Nevertheless, the widely diffused intellectual activity of the present, in which even metaphysics is represented by a greater number of schools than ever before, and which, for the first time in the history of the world, has a broad basis of scientific facts, cannot but tend towards a still higher intellectual condition. One of the most important steps in this direction will surely be a synthesis of the now comparatively isolated departments and schools of human knowledge and thought.

No factor is more promising than the new scientific theories of education; which ought of themselves, when their application has become more general, to develop within a few generations a new and superior type of mind.

No theory about the psychological future of mankind can afford to ignore the strange possibilities opened up by the science of hypnotism. This is a most fruitful field of speculation. We live in a period of esthetic decadence; but neither can esthetic development be left out of account. The esthetic faculty contributes more than any other to individual happiness, and it may be capable of being brought by systematic cultivation to a degree of perfection hitherto unknown.

To sum up, it would seem that there is an undoubted material progress under way, from which wonderful and startling results are to be anticipated, but which will not, unless accompanied by a great intellectual decadence, terminate, as Dr. Shufeldt predicts, in a total destruction of the forests, or, indeed, of any portion of the flora or fauna of the globe which has even a picturesque or decorative value. The wide-spread idea that the development of material resources is all there is of progress, is both an effect and a cause of a temporary tendency to physical, social, and psychological retrogression.

Neither our senses nor our memories are as acute as those of our barbarian ancestors; our taste and capacity for intellectual speculation is not as great as was possessed by our predecessors of the scholastic period, or by the south Asiatic Aryans of any historic time; the ideals of strength and intensity embodied in the Niebelungenlied, those of delicacy and grace which gave rise to the Arthurian legends, and those of divine love and beauty which inspired the Old Masters, have alike become dim and distant to us; and the low vice of avarice rules the day.

But never before was the sum of human knowledge so vast; never were all questions, physical, social, and psychological, studied so carefully and in so full a light; never was the importance of education, and of right education, so generally recognized and insisted upon; and never has the race seemed so near to that fusion into one great world-nation which is indispensable to a universal distribution of the knowledge and ideas and materials which are now of but local utility.

The tendency of the times is to subordinate man to civilization; but civilization is useless except in so far as it promotes the happiness or personal development of man. If any real improvement is to be accomplished in the race itself, in contradistinction to its material environment, there will evidently be necessary a systematic encouragement of that salutary inequality by which favorable variations are husbanded and a specialization of function in the social organism secured.

I cannot venture, in view of the complexity of the problem, to hazard a prediction even for the next stages of human evolution, to say nothing of the millions of years over which Dr. Shufeldt so gaily gambols. His very dramatic picture of the last man can, however, never be realized in fact unless the expected modification in the human organism shall amount to a radical transformation. It is inconceivable that man should be the last of all living forms to disappear during the process of the earth's cooling. As at present constituted, he would succumb, even with all the appliances of civilization, long before many of the lower species. Most of the latter could, in no supposition, be exterminated by him, and many of them, as the doctor well knows, possess incredible powers of resistance to unfavorable climatic and other conditions.

Speculations regarding so very remote a future are of doubtful utility, especially in view of the daily possibility of one of those celestial casualties familiar to astronomers, such as a collision with a dead sun. I forbear to picture the sublime horrors of such an event, but they may at any moment be realized, though with such rapidity that before any human mind could guess the truth the whole solar system would have been dissolved, by the heat resulting from the impact, into invisible vapor.

Merwin Marie Snell.

Washington, D.C., Oct. 26.

Government Science.

The communication of Eugene Murray Aaron in the issue of *Science* for Oct. 23, under the above heading, contains statements and presents conclusions which I believe to be well founded. Like that writer, I am warmly in favor of the recent reforms in the methods of filling vacancies in the various departments of the civil service, in positions where technical and scientific knowledge is not required. But I am firmly of the opinion that if the heads of scientific bureaus were allowed to select their assistants, subject of course to the approval of the Civil Service Commission, far better results would be secured.

An instance was recently reported to me similar to the case cited by Mr. Aaron. A Washington daily contained the announcement of a vacancy in a subordinate position requiring special scientific attainment. A few young men, hanging around Washington for something to turn up, saw the advertisement as soon as it appeared, and at once placed themselves under instruction to "cram" for the examination. The one of their number who showed the highest average secured the position.

A man far more competent to fill it, residing many miles from Washington, was urged by friends to make application. His letter of inquiry was received too late, and thus a tyro was appointed when an expert might have been secured, to the expressed disgust of eminent scientists in government employ. C.

Highlands, N.C., Oct. 30.

Words of Algonkian Origin.

The Chinook jargon, that *lingua franca* of the region of the Columbia, has recruited its vocabulary from many different sources. Amongst others the Algonkian tongues have contributed their share towards the formation of this linguistic mosaic.

In the "Partial Vocabulary of the Chinook Jargon," given in 1863, by Theodore Winthrop (Canoe and Saddle, Boston, 1863. New ed., Peterson, Edinburgh, 1883, pp. 211–214), we find the following words of Algonkian origin:

Kinni-kinnik, = smoking-weed,
Tatoosh, = milk, cheese, butter.
Wapato, = potato.

The word *moos moos*, "beef," "cattle," which also occurs, is probably not Algonkian. It occurs in a vocabulary of the "Chenook" of Fort Vancouver, and the "Calapooa," collected before the year 1840, by the Rev. Samuel Parker (see Journal of an Exploring Tour beyond the Rocky Mountains, Ithaca, 1840, pp. 393, 398).

George Gibbs, in his "Dictionary of the Chinook Jargon, or Trade Language of Oregon" (Smithson. Miscell. Coll. 161, Washington, 1863, pp. xiv., 44), attributes a Cree origin to two, and a Chippeway origin to one, of the 490 words of which the jargon was then composed. These words, regarding which he observes: "The introduction of the Cree and Chippeway words is of course due to the Canadians" (p. viii.), are as follows: "*Mit-ass, n.* Cree, Mitas (Anderson). Leggings. A word imported by the Canadian French (p. 17). *Sis'-ki-you, n.* Cree (Anderson). A bob-tailed horse (p. 23). *Totoosh*, or *Tatoosh, n.* Chippeway, totosh (Schoolcraft). The breasts of a female, milk. *Totoosh lakles* [*la graisse*], butter."

The other words, the second of which is clearly Algonkian, Gibbs thus describes: "*Moos-moos n.* Klikatat *músmus;* Chinook, *emúsmus.* Buffalo, horned cattle. The word, slightly varied, is common to several languages. Mr. Anderson derives it from the Cree word *moostoos*, a buffalo, and supposes it to have been imported by the Canadians; but Father Pandosy makes *músmus* Yakama" (p. 17). "*Wap pa-too, n.* Quære, *u. d.* The root of the *Sagittaria sagittifolia*, which forms an article of food; the potato. The word is neither Chinook nor Chihalis, but is everywhere in common use" p. 28). "*Le-pish'-e-mo, n.* Quære, *u. d.* The saddle-blanket and housings" (p. 15).

The last of the above three words is most likely of mixed French and Algonkian etymology.

In the "Manual of the Oregon Trade Language, or Chinook Jargon," published by Mr. Horatio Hale in 1890, the following words occur without their Algonkian origin being indicated:

Lepishemo (lipishímo), saddle housing (p. 47).
Mitass, J [argon] (mitás), leggings (p. 48).
Totoosh, J [argon] (totúsh), breast, udder, milk (p. 52).

And the English-Chinook vocabulary yields the following, of which the origin is likewise not noted:

Breasts, *totoosh* (p. 54).
Butter, *totoosh lakles* (*la graisse*, Fr.), p. 23.
Leggings, *mitass* (p. 57).
Milk, *totoosh* (p. 58).
Potato, *wappatoo* (p. 59).

The word *moosmoos* also finds place in Professor Hale's vocabulary, with the meanings "buffalo, cattle, ox," and is set down as [Chinook] (p. 48). The words of Algonkian origin which are to be found in the vocabulary of Chinook, as given by the above authorities, are consequently: *Kinni-kinnik*, [*le*] *pishemo, mitass, siskiyou, totoosh, wappatoo.*

Regarding the etymology of these loan-words, the following may be said:

Kinni-kinnik. Derived directly or indirectly from Otcipwē. The cognates are Otcipwē (Baraga) kiniginige, "I am mixing together something of different kinds." (Cuoq) *kinikinige*, "mêler ensemble des choses de nature différente." The radical is seen in Algonkin (Cuoq) kinika, "pêle-mêle" = Cree *kiyekaw*.

Lepishimo. This word evidently consists of the French article *le* and a radical [*a*]*pishemo*. This latter corresponds to the Otcipwē (Baraga) *apishamon*, "anything to lie on; a bed; *apishemo*, "I am lying on something." Compare the western Americanism *apishamore*, which Bartlett (Dict. of Americanisms, 1877) thus defines: "*Apishamore* (Chippewa, *apishamon*). Anything to lie down on; a bed. A saddle-blanket made of buffalo-calf skins, much used on the prairies."

Mitass. Directly or indirectly (through French-Canadian) from Otcipwē or Cree. The cognate words are: Otcipwē (Baraga), *midâss;* Algonkin (Cuoq), *mitas;* Cree (Lacombe), *mitâs*. The word exists in Canadian-French in the form *mitasse*. Dr. Franz Boas kindly informs me that "legging" in Chinook and Clatsop is *imētas*.

Siskiyou. Though this word is assigned a Cree origin by Mr. Gibbs, its etymology is very uncertain. Blackfoot *sakhsiu*, "short," and Cree *kiskikkuttew*, "he cuts in two," offer themselves for comparison, but with no certainty.

Tatoosh, totoosh. From Cree or Otcipwē. The cognate words are: Cree (Lacombe), *totosim*, "mammelle, pis;" Otcipwē (Baraga), *totosh*, "breast, dug, udder;" Alkonkin (Cuoq), *totoc*, "mammelle."

Wappato, wappatoo. From Cree or Otcipwē. The cognate words are: Cree (Lacombe) *wâpatow*, "champignon blanc;" Otcipwē (Baraga), *wâbado*, "rhubarb;" Algonkin (Cuoq) *wabato*, "rhubarbe du Canada." It is in all probability a derivative from the root *wap-*(*wab*), "white."

Another word may be added to the list, viz., *pāpūs* (*papoose*) = child. This word is used by the speakers of Chinook in eastern British Columbia. The Algonkin origin of the word has been disputed by some, but there is every reason to believe that it is connected with the root seen in the Massachusetts *papeississu* (Eliot) = "he is very small;" *peisses* (Eliot), "child;" *pe-u* (Eliot), "it is small." From this root there seems little doubt that the word *papoos* or *papoose* found in Roger Williams, and in Wood ("New Engl. Prospect"), has been derived, as Dr. Trumbull points out.

It might be remarked that the words *kinni-kinnik, lepishemo, mitas, totoosh, wapato*, and *papoose* were all heard by the writer in western British Columbia in the summer of the present year, so they are still in use as part of the jargon. The word *siskiyou* was not heard and is probably obsolescent.

It is a remarkable and an interesting fact that the Algonkian family of languages has borne its part in the formation of the curious jargon of the Pacific coast of North America. The presence there of these words is due in part to isolated Otcipwēs and Crees who have crossed the Rockies, and to the French-Canadian half-breeds in whose language these words are also to be found.

A. F. CHAMBERLAIN.

Worcester, Mass., Oct. 24.

Auroral Phenomena.

ON Sept. 9 there was seen at Lyons, N.Y., a band of light narrower than the Milky Way, arising from the western horizon and passing nearly vertically through the constellations of the Northern Crown and Lyre, just south of the zenith, and thence downward at times to the eastern horizon. There was an aurora at the time in the northern sky, but this band maintained its position throughout the evening entirely independent of the display, although varying somewhat in brightness in sympathy with the aurora and evidently being itself of an auroral nature. On Sept. 10 and 11 an aurora was visible in Great Britain, and, as appears from descriptions in *Nature* for Sept. 17 (p. 475) and Sept. 24 (p. 494), a band of light similar to that which constituted such a remarkable feature in the display at Lyons was likewise seen in that locality also. Other instances have been noted by the writer in which some peculiarity of form or color has attended an outbreak of the aurora on both sides of the Atlantic.

There is this evening in the western sky a magnificent display of red light similar to the sunset glows which attracted so much attention a few years since. Three-quarters of an hour after sunset the entire western heavens are lurid red, resembling the reflection from a conflagration.

M. A. VEEDER.

Lyons, N.Y., Oct. 29.

Chautauqua and other Iroquois Names.

MR. ALBERT S. GATSCHET has kindly sent me his paper on the "Origin of the Name Chautauqua," of which he says, "All the information above was obtained from J. N. B. Hewitt, in Washington, D.C.," but I may be permitted to add a few words on this and other names. I may premise that I have a list of about 1,200 Indian names of places in New York, about half of which are either obsolete, or applied to places little known. Many local names can be obtained of the Indians on any reservation.

First, of pronunciation, in which Mr. Gatschet's informant differs from other authorities. It is a little too positive to say that "To spell it 'Chatakwa' would conform better to scientific orthography, for the first two syllables are both pronounced short." Having but accidentally used the name in conversation with my Onondaga friends, it is of little importance to say that they gave it the usual pronunciation, for I was simply trying to get its meaning. Others, who have given it attention, are quite decided on this point. Mr. O. H. Marshall was an acknowledged authority on local Indian names. In his "De Celoron's Expedition to the Ohio," he gives several forms. Among these, Alden wrote it as pronounced by the Seneca chief Cornplanter, "Chaud-daukwa." Mr. Marshall adds, "It is a Seneca name, and in the orthography of that nation, according to the system of the late Rev. Asher Wright, long a missionary among them, and a fluent speaker of their language, it would be written 'Jah-dah-gwah,' the first two vowels being long, and the last short." Mr. L. H.

Morgan gives the name in all but the Oneida dialect, and with but slight variation. In all he makes *a* sound as in far. The French spelling would prove but little, but Sir William Johnson wrote it "Jadaghque," and thus it appears on Lake Erie, on the boundary map of 1768.

Mr. Marshall took notice of the various meanings ascribed to the name, as "The place where a child was swept away by the waves;" "the foggy place;" "the elevated place;" "the sack tied in the middle;" but preferred the one given him by "Dr. Peter Wilson, an educated Seneca." This was "where the fish was taken out;" agreeing with the meaning furnished Mr. Gatschet. As Mr. Marshall's paper is not accessible to all, I copy the tradition, which is very simple, as given by Dr. Wilson. "A party of Senecas were returning from the Ohio to Lake Erie. While paddling through Chautauqua Lake, one of them caught a strange fish and tossed it into his canoe. After passing the portage into Lake Erie they found the fish still alive, and threw it in the water. From that time the new species became abundant in Lake Erie, where one was never known before. Hence, they called the place where it was caught Jah dah-gwah, the elements of which are Ga-joh, 'fish,' and Ga-dah-gwah, 'taken out.' By dropping the prefixes, according to Seneca custom, the compound name 'Jah-dah-gwah' was formed."

Mr. Gatschet simply reverses this story, taking the fish from Lake Erie. On the other hand, we have another careful writer, Mr. Morgan, interpreting the name as the "Place where one was lost."

From various old documents it is evident that the name was applied to the lake and also to the nearest spot on Lake Erie. It first appears in De Celoron's journey, but was evidently in use before. A lead plate, which the Indians purloined from him, was marked by mistake to be placed at the confluence of the Ohio and the Tchadakoin, July 29, 1749. In the one buried, this was corrected to the confluence of the Ohio and Kanaaiagon, now the Conewango. De Celoron reached the Chatakouin portage July 16, 1749, "and arrived at the end of the portage, on the banks of Lake Chatacoin, on the 22d."

It is quite probable that the portage terminating at Chautauqua Lake on the one hand, gave the name to the landing on Lake Erie on the other, according to Indian custom. This spot is often referred to about that time. Stephen Coffen, in 1753, being then with a body of French, "arrived at Chadakoin on Lake Erie, where they were ordered to fell timber, and prepare it for building a fort there." M. Morang liked the place no better than De Celoron had done, "the river of Chadakoins being too shallow to carry any craft with provisions, etc., to Belle Rivier." M. Mercie found another place at Erie, "fifteen leagues to the south-west of Chadakoin." Others used similar terms. On his map of 1758, M. Pouchot applies the name to the Conewango, calling the stream flowing from the lake the River Shatacoin. He seems singular in this, as Chautauqua Creek had been thus called but a few years before.

Mr. Gatschet explains the use of the prefix T'ka, much as Morgan does. The latter, however, invariably gives the full sound, Tecar, or Teka, instead of the shortened, which is customary. In first taking down names from the Onondagas I did the same, being anxious to have every syllable fully pronounced, but soon found that this did not give the word sound. In this case that is best preserved by T'kah, which I have long used.

The discrepancy in the translation of Indian words is at first surprising, but many are purely the fancies of white men, and these are as persistent as any. Thus, in a familiar instance, Skaneateles, which means "long lake," is pertinaciously rendered "beautiful squaw." Cayuga is an instance where the Indians themselves do not agree, for it was translated "at the mucky land" for Mr. Morgan. David Cusick says it means "mountain rising from water," while Albert Cusick translated it for me as "where they drew their boats out of the water." I am inclined to think this difference may be more apparent than real, all possibly referring merely to an incident in the Hiawatha legend.

Indian names in New York come from very trivial things, and probably always have. Honcoye, "a finger lying," is a case in oint. The amputated member, lying in the way, was a matter of comment or description, and affixed itself to the village more than the place. Once the name of a town it migrated with the town. The favorite village name of Ka-no-wa-lo-hale, "head on a pole," was used in more than one place at the same time.

I have noted one curious thing in Indian pronunciation, that they do not always pronounce names among themselves as they do to the whites, so that error is often perpetuated on the best of authority. An Onondaga never pronounces the name of his nation in conversation among the whites as he does among his own people, but invariably gives *a* the long instead of broad sound, which he always uses in his own language in this word. I do not know how this commenced, but it was long ago, and may have come from early attempts to conform to supposed rules among us. It is a curious fact, however, and shows the need of care in taking down words.

Among the sonorous names preserved in New York, very few are poetical, and where they are made such, with rare exceptions, their correctness may be suspected. They are seldom unaltered, letters being changed or syllables dropped. In a large proportion of cases they are rendered in the Mohawk dialect west of Albany, as that people was most directly in contact with the colonists. Thus we frequently find Mohawk pronunciation in the territory of the Onondagas and Senecas

As in the case of Chautauqua, names are often taken from one place and applied to another. Schenectady, "Beyond the pines," is an instance. It belongs to Albany, but became expressive when used in either way. When Corlaer bought Schenectady the Indians knew it as Schonowe, "the great plain." The name of Onondaga followed the various removals of the village, and this is true of most of the Seneca towns. As with us, the same names would co-exist. The Oneidas had, among their lakes, Skaniadoris; the Onondagas, Skaneateles; the Senecas, Skaneatice; all meaning a long lake, but not necessarily large. The allusions to hemlocks, in the same way, are quite frequent.

One cause of confusion in the interpretation of names is the similarity of sound. The name of Canastota is probably rendered correctly Kanetota, "a pine tree standing alone;" but the Onondagas know it as Kanosta, "the frame of a house," which they greatly admired when the first one was built there. A facetious friend has suggested a Latin derivation from *canis totus*, the whole dog, which would do quite as well as many interpretations of Indian names. Occasionally one meets with a name strongly suggestive of European origin. Two of these are quite noteworthy. One is that of Tappan, a well known personal name with us, but also that of an early Indian tribe, living on Tappan Bay, on the Hudson River. Of this Heckwelder long ago wrote, "This is from the Delaware language, and derived from Thuphane, or Tup-han-ne, 'Cold Spring.'" The other is the name Seneca, which appears on Dutch maps as early as 1614. The Dutch knew the Iroquois only as the Mohawks and Senecas, and used the names by which the Algonquin tribes called them. Both divisions had strong cannibal tastes, and for this were held in abhorrence by other nations. The Mohawks were known in New England as "men-eaters," and the name of the Senecas seems to have had much the same meaning elsewhere. Of course it is no more an Iroquois word than Maqua or Mohawk. It may come from the radical word *sinni*, "eat," and probably does.

Niagara has no allusion to the falls, but is simply a "neck," suggested by its connecting two great lakes. It takes many forms, and the Neutrals called it On-gui-a-ah-ra in 1640, having a village there of the same name. As the name of Erie means a cat, I had some doubt, for a time, whether Cusick's translation of another name of Lake Erie, Kau-ha-gwa-rah-ka, "a cap," might not be a misprint, but it is correct. There were several names, of course, for that lake. The Onondagas know Lake Ontario as the lake at Oswego, but in the middle of the last century they called Lake Erie Sa-hi-qua-ge, which the English rendered Swee-ge. The carrying place at Niagara was then known as Och-swee-ge. Oswego river first appears by this name in 1670, with French spelling, and where the present Seneca River leaves Cayuga lake. Father Raffeix said, "The river Choueguen, which rises in this lake, soon branches into several canals." The French sometimes prefixed the letter *O*, but their pronunciation must be allowed for in all Indian words we have from them. The English usually called the Oneida and Oswego Rivers the Onondaga. In a similar way Genesee River was often termed the Seneca.

These notes need not be carried further, for it is my present purpose merely to direct attention to a few points. Examination will show that large numbers of Indian names are still in use, but with no better meanings than our own.

W. M. BEAUCHAMP.

Baldwinsville, N.Y., Oct. 31.

Battles and Rain.

IN *Science* for Oct. 16 I quoted the only part I had then seen of the now rather famous reference by Plutarch to the occurrence of rain after great battles, and I then considered it as having the meaning commonly ascribed to it. Mr. Powers, however, now tries to show that the commonly accepted meaning is erroneous, and supports himself by the original passage. It seems to me that the ordinary view is correct, and that Mr. Powers, by omitting a portion and by an incorrect interpretation of the passage, has been misled. I will give the passage as translated by Langhorne, italics, punctuation, and all.

"From these writers [historians] we learn, that the Massilians walled in their vineyards with the bones they found in the field; and that the rain which fell the winter following, soaking in the moisture of the putrefied bodies, the ground was so enriched by it, that it produced the next season, a prodigious crop. Thus the opinion of Archilochus is confirmed, that *fields are fattened* with blood. It is observed, indeed, that extraordinary rains generally fall after great battles; whether it be that some deity chooses to wash and purify the earth with water from above, or whether the blood and corruption, by the moist and heavy vapors they emit, thicken the air, which is liable to be altered by the smallest cause." Dryden's translation begins this last statement as follows: "It is an observation, also, that extraordinary rains pretty generally fall after great battles," etc.

It will be seen at once that the last part of this statement by Plutarch has a very different meaning from the first. It would be a remarkable climate that would permit the blood to remain on the earth, or thicken the air with moist and heavy vapors, six months more or less. The extraordinary rains referred to must have occurred very soon after the battle. These served to soak the corruption (which would begin in a very few hours in that climate) and the blood into the surface soil, and thus tended to purify the surface, as Plutarch says. The rains of the subsequent winter carried this material still deeper, and enriched the crops. Plutarch does not connect the two rains together, but rather carefully separates them by the clause referring to Archilochus. The rains of the winter following were evidently gentle, long-continued, and crop producing, and not like the earlier extraordinary rains immediately after the battle and lasting, probably, a few hours only. It would seem as though a good understanding of this earlier view may help prove the falsity of the later regarding explosions and rain.

H. A. HAZEN.

Washington, D.C., Nov. 3.

BOOK-REVIEWS.

Christopher Columbus and how he received and imparted the Spirit of Discovery. By JUSTIN WINSOR. New York, Houghton, Mifflin, & Co. 8°. $4.

Now that the fourth centenary of the discovery of America is close at hand, books relating to that event, and to the man who brought it to pass, are likely to be abundant. We doubt, however, if any of the rest of them will equal in interest and importance this work of Mr. Winsor. It is written in the spirit and with the methods of the best historical criticism, and with a sincere endeavor to discover and state the real truth. On the one hand, it presents the significance and results of Columbus's work in a clear and impressive light, while on the other it endeavors to set forth with historical fidelity the lineaments of his character. Its literary merits, too, are considerable, the style being strong and incisive, yet at the same time clear and easy flowing. The opening chapters, which treat of the documentary sources from which the life of Columbus has to be learned, are somewhat too technical for the ordinary reader, and similar passages occur in some other parts; but the narrative portions of the book are as interesting as they are instructive. We need not dwell, however, on these features of the book, as the events of Columbus's life are too well known to need recapitulating here, and Mr. Winsor does not profess to have discovered any new sources of information. He has simply followed the original authorities, so far as these are now available; and the merit of his work lies in the fidelity and skill with which he sifts his authorities and interprets the facts.

The first thing that we wish to know about any prominent historic character is the nature and significance of his life work and its effect upon the world. In the case of Columbus the significance of his work was far different from what he himself supposed, and its ultimate results such as he never dreamed of; yet he was none the less the master spirit in the work of discovery, and is entitled to all the honor which that distinction can give him. How great and far-reaching the results of his work were is clearly set forth by Mr. Winsor, especially in his appendix, in which he traces the history of succeeding discoveries down almost to the present day. He shows, as others have shown, that Columbus's ideas about the sphericity of the earth and the possibility of reaching Asia by the west were derived from earlier thinkers, and adds, "There was simply needed a man with courage and constancy in his convictions, so that the theory could be demonstrated. This age produced him." Mr. Winsor makes little account of the alleged discovery of America by the Norsemen, though he does not deny the possibility of such discovery; but he thinks that the story of their voyages could have had no influence on Columbus, and was in all probability unknown to him. In connection with his account of Columbus's voyages and those of his contemporaries, and also in recounting the discoveries since his day, Mr. Winsor lays before us a great number of ancient maps, in which the growth of geographical knowledge can be clearly traced. Indeed, his treatment of the scientific aspects of his subject is as full as could be desired.

But the feature of his book that will excite the most interest is his estimate of Columbus's character, which is emphatically iconoclastic. He evinces no spirit of hostility to the great navigator, though he has some some sarcastic remarks about Irving, De Lorgues, and other biographers; but he shows by well attested facts that Columbus was far from possessing the nobleness of character that has usually been attributed to him. He says very truly that a man like Columbus ought to be judged by a high moral standard — the standard of all ages; but that when so tried the great discoverer is found wanting. The principal charge brought against him is that he originated and persistently followed the practice of enslaving the native Americans and of selling them as slaves in the markets of Spain, thereby becoming the originator of American slavery. This accusation, though by no means new, is supported in this book by overwhelming evidence, so that it is hard to see how any fair-minded man can deny or palliate it; and it throws a very dark shadow over the fame of Columbus. Mr. Winsor also charges him with deceit, cupidity and arrogance, and there is, unfortunately, great difficulty in rebutting these charges. His final judgment on the man who discovered the New World is as follows: "Its discoverer might have been its father; he proved to be its despoiler. He might have given its young days such a benignity as the world likes to associate with a maker; he left it a legacy of devastation and crime. He might have been an unselfish promoter of geographical science; he proved a rabid seeker for gold and a viceroyalty. He might have won converts to the fold of Christ by the kindness of his spirit; he gained the execrations of the good angels" (p. 512).

The world is so accustomed to the opposite view of Columbus's character that many readers will reject the portrait that Mr. Winsor has drawn of him; but we incline to think that it is the one that will eventually be accepted by impartial minds. In any case Mr. Winsor's narrative and arguments are worthy of all attention, and we heartily commend his book to our readers.

AMONG THE PUBLISHERS.

In the *New England Magazine* for November, C. S. Plumb writes of "A Future Agriculture."

— Dr. Wyatt's work on "The Phosphates of America" is announced as in preparation by the Scientific Publishing Company of this city.

— The *Review of Reviews* seems to have come to the aid of the Society for Psychical Research. It is about to publish, in an early number, a batch of modern ghost stories as a sort of contribution to a "census of hallucinations."

— D. C. Heath & Co., Boston, will issue shortly a beginner's book in Old English (Anglo-Saxon), by George Hempl, professor of English in the University of Michigan. It will consist of elementary grammar and easy texts suitable as introductory to advanced grammar and reading, though sufficient for the usual course in Old English in colleges that give but one course, and in high schools.

— President F. A. Walker's standard works on "Money" and on "Wages" are attracting much attention in England, whither several editions have been sent and where reference to them in the university extension circulars is frequent. The demand for a popular edition in this country and in England will shortly be met by Messrs. Henry Holt & Co., who will issue the two works at a lower price than heretofore.

— The November number of *Babyhood* closes its seventh volume. It contains an article on "The Family Medicine Chest," by the medical editor, which gives instructions as to what ought to be kept on hand in every household for use in an emergency. At the same time the writer points out the dangers of indiscriminate domestic doctoring. Other medical articles of interest to mothers are "The Care of Delicate Infants" and "Bathing for Sick Children." The "Nursery Table" tells how to prepare palatable nursery dishes, and the "Nursery Helps and Novelties" and "Nursery Problems" furnish useful hints and advice concerning the many perplexing questions which parents of young children have to solve. In the "Parliament" the mothers discuss the habit of eating "between meals," the homesickness of children, the baby's photograph, the influence of Punch and Judy on children, etc.

— In the *Educational Review* for November President Hyde of Bowdoin points out what is to be the policy of the small college, now that great universities have been developed. Dr. William H. Maxwell has a paper on the "Literature of Education." Miss Annie Tolman Smith describes the provisions made in Europe for the pensioning of superannuated teachers, and suggests the inauguration of a similar policy here. Professor William B. Smith of the University of Missouri in an article entitled "Twelve *versus* Ten," argues for the overthrow of the decimal system of numeration. The discussions on city school supervision and practice teaching

Publications received at Editor's Office, Oct. 21–Nov. 3.

BOLLES, F. Land of the Lingering Snow. Boston, Houghton, Mifflin. 234 p. 12°. $1.25.
CIRCULAR System, The Organ of the Circular System of Science. Vol. I. No. 1. *m.* Oakland, Cal., W. W. Felts. 8 p. f°. $1 per year.
HELLYER, S. S. Principles and Practice of Plumbing. New York, Macmillan. 294 p. 12°. $1 25.
LOCK, J. B. Mechanics for Beginners. Part I. Dynamics and Statics. New York, Macmillan. 264 p. 12°.
MASSACHUSETTS, Twenty-second Annual Report of the State Board of Health of. 588 p. 8°.
"STYX," of the H. B. of L. Hermetic Philosophy. Vol. II, Philadelphia, Lippincott. 310 p. 12°. $1 50.
THOMPSON, E. P. How to Make Inventions. New York, Van Nostrand. 161 p. 8°.
WEBB, H. L A Practical Guide to the Testing of Insulated Wires and Cables. New York, Van Nostrand. 118 p. 12°. $1.
WEED, C. M. Insects and Insecticles. The Author, Hanover, N. H. 281 p. 8°.
WINSOR, Justin, Christopher Columbus, and how he received and imparted the Spirit of Discovery. Boston, Houghton, Mifflin & Co. 8°. $4.
WOOD, H. T. Light, an Elementary Treatise. New York, Macmillan. 143 p. 12°. 75 cents.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For Sale or Exchange for books a complete private chemical laboratory outfit. Includes large Becker balance (200g to 1-10mg), platinum dishes and crucibles, agate motors, glass-blowing apparatus, etc. For sale in part or whole. Also complete file of *Silliman's Journal* 1862-1885 (62-71 bound); Smithsonian Reports, 1854-1883; U. S. Coast Survey. 1854-1869. Full particulars to enquirers. F. GARDINER, JR., Pomfret, Conn.

For exchange or sale at a sacrifice, an elaborate microscope outfit. Bullock stand; monocular objectives, one-sixth homeogeneous immersion, four-tenths, and three inch, Bausch & Lomb, also one-fourth and one inch Spencer. Four eye-pieces. Objectives are the best made. Address Mrs. Marion Smith, 41 Branch Street, Lowell, Mass.

For sale or exchange, extra fine pair (♂ and ♀) of skins of Rocky Mountain Goat, with the skulls, etc., as needed for mounting; collection of vertebrate fossils from the Coup Fork Tertiary of Kansas; collection of works on descriptive cryptogamic botany—mostly on *Fungi;* thirteen vols. of *Botanical Gazette*, eight vols. *Grevillea*, four vols. *Notarisea;* stereopticon outfit, with attachment for microscopic projection; 148 stereopticon slides, illustrating zoology and cryptogams. Wanted—American and foreign works and pamphlets on Vertebrate Palæontology, and series of *Am. Jour. of Science* and other periodicals containing contributions to Vertebrate Palæontology. Prof. F. W. Cragin, Colorado Springs, Colo.

are continued by Superintendent Greenwood of Kansas City and Chancellor W. H. Payne of Nashville, Tenn. There are also articles on "Women as Teachers," "Recent Changes in the Regents Examinations in New York," "The New School Law for St Paul, Minn.," the "Socratic Method of Teaching," and the "Educated Proletariat of Germany." The book-reviews are by Professor Woodrow Wilson of Princeton, Professor A. B. Hart of Harvard, Professor F. H. Giddings of Bryn Mawr, President C. F. Thwing of Western Reserve University, Professor Henry C. Johnson of Philadelphia, and the editors.

— After years of labor by the editor, John Foster Kirk, and his assistants, the supplement to "Allibone's Dictionary of English Literature and British and American Authors" is announced by J. B. Lippincott Company as now completed, thus extending and bringing down to the latest practicable date one of the great literary enterprises of the century. Begun in 1850, and for the most part written in the few following years, the three original volumes of Dr. Allibone's work of necessity fail to contain an account of a vast number of books that have of late been published. To supply this deficiency and thus present in a single series of volumes a complete bibliography of English literature from the earliest times to the present (as nearly as possible) has been the aim of the publishers in issuing this supplementary section of the work. Altogether, 37,183 authors, with their works (93,780 in number), are recorded in the supplement, with frequent biographical and bibliographical notices, the latter embracing in many instances criticisms of the works mentioned, from the leading reviews of the day.

— In the *Atlantic Monthly* for November S. E. Winbolt's paper, "The Schools at Oxford," is an account of the work and the examinations that are necessary for a degree from the university. The paper is particularly interesting as showing the difference in the manner of attaining a degree in the English and American universities.

SCIENCE

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NINTH YEAR.
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NEW YORK, NOVEMBER 13, 1891.

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QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19. No response to date.

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To exchange Wright's "Ice Age in North America" and Le Conte's "Elements of Geology" (Copyright 1882) for "Darwinism," by A. R. Wallace, "Origin of Species," by Darwin, "Descent of Man," by Darwin, "Man's Place in Nature," Huxley, "Mental Evolution in Animals," by Romanes, "Pre-Adamites," by Winchell. No books wanted except latest editions, and books in good condition. C. S. Brown, Jr., Vanderbilt University, Nashville, Tenn.

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SCIENCE

NEW YORK, NOVEMBER 13, 1891.

GOVERNMENT TIMBER TESTS.

In reply to many inquiries regarding the comprehensive timber tests inaugurated in the Forestry Division of the Department of Agriculture, the following brief statements regarding the objects and methods of the work have been prepared by B. E. Fernow, chief of the division, in the hope that thereby an interest in this investigation, a work of national importance, may be spread.

It will be admitted by all who have to handle wood in building, engineering, and manufacturing, that our knowledge regarding the properties of our various timbers is not very satisfactory, and that while attempts more or less systematic have been made to determine these properties, and knowledge gained from experience exists among those who have handled certain classes of wood for certain purposes, there does not exist much reliable published information for general use.

The reason for this deficiency may be explained from the fact that wood, being a non-homogeneous material, varies very largely in its qualities. Not only does there exist a wide range of qualities in the same species if grown under different conditions, but the quality varies in the same tree from the butt to the top, and from the heart to the bark.

To arrive, then, at any satisfactory results in an experimental determination of the properties of wood, it is necessary to derive them from test material of known origin, and, furthermore, to establish any laws which will be generally applicable in referring quality to physical appearance, structure, and origin of material, it is necessary to examine and test carefully a very large number of test specimens.

The difficulty for private enterprise to secure the test material in sufficient quantity, and with a full knowledge of its origin, in fact the magnitude of an investigation of this kind, renders it pre-eminently an undertaking for a government agency. This has also been recognized by the Prussian Government; but the United States Department of Agriculture can boast of having inaugurated such elaborate work one year earlier.

The object of this work in general will be readily perceived from the foregoing statement.

Besides more reliable data regarding the properties of our principal timbers, there is to be gained from this investigation a means of determining quality by the examination of physical appearance and structure, and of establishing an inter-relation between quality and conditions of growth.

To define the objects of the work more in detail, some of the questions which it is expected ultimately to solve may be formulated as follows: —

What are the essential working properties of our various woods and by what circumstances are they influenced? What influence does seasoning of different degree have upon quality? How do age, rapidity of growth, time of felling, and after-treatment change quality in different timbers? In what relation does structure stand to quality? How far is weight a criterion of strength? What macroscopic or microscopic aids can be devised for determining quality from physical examination? What difference is there in wood of different parts of the tree? How far do climatic and soil conditions influence quality? In what respect does tapping for turpentine affect quality of pine timber?

It is also proposed to test, as opportunity is afforded, the influence of continued service upon the strength of structural material, as, for instance, of members in bridge construction of known length of service. This series of tests will give more definite information for the use of inspectors of structures.

There are four departments necessary to carry on the work as at present organized, namely: the collecting department, the department of mechanical tests, the department of physical and microscopic examination of the test material, the department of compilation and final discussion of results.

The collection of the test material is done by experts (Dr. Charles Mohr of Mobile, Ala., for southern timbers). The trees of each species are taken from a number of localities of different soil and climatic conditions. From each site five trees of each species are cut up into logs and disks, each piece being carefully marked, so as to indicate exactly its position in the tree; four trees are chosen as representative of the average growth, the fifth or "check tree" the best developed specimen of the site.

Disks of a few young trees, as well as of limbwood, are also collected for biological study. The disk pieces are eight inches in height and contain the heart and sapwood of the tree from the north to the south side of the periphery. From fifty to seventy disk pieces and from ten to fifteen logs are thus collected for each species and site.

A full account of the conditions of soil, climate, aspect, measurements, and determinable history of tree and forest growth in general accompanies the collection from each site.

The disks are sent, wrapped in heavy paper, to the Botanical Laboratory of the University of Michigan, at Ann Arbor (Mr. F. Roth, in charge), to be studied as to their physical properties, their macroscopic and microscopic structure, rate of growth, etc. Here are determined, (*a*) the specific weight by a hygrometric method; (*b*) the amount of water and the rate of its loss by drying in relation to shrinkage; (*c*) the structural differences of the different pieces, especially as to the distribution of spring and summerwood, strong and weak cells, open vessels, medullary rays, etc.; (*d*) the rate of growth and other biological facts which may lead to the finding of relations between physical appearance, conditions of growth, and mechanical properties. The material thus studied is preserved for further examinations and tests as may appear desirable, the history of each piece being fully known and recorded.

The logs are shipped to the St. Louis Test Laboratory, in charge of Professor J. B. Johnson. They are stenciled off for sawing and each stick marked with dies, corresponding to sketch in the record, so as to be perfectly identified as to number of tree, and thereby its origin, and as to position in tree. After sawing to size, the test-pieces are stacked to await the testing. One-half of every log will be tested green, the other half after thorough seasoning. A determination is made at the time of testing of the amount of water present in the test-piece, since this appears greatly to influence results.

From each tree there are cut two or three logs, from each log three or four sticks, two of standard size, the other one or two of larger size. Each standard stick is cut in two, and one end reserved for testing two years later after seasoning. The standard size for the sticks is 4 × 4 inches and 60 inches long for cross-breaking tests. There will, however, be made a special series of cross-breaking tests on a specially constructed beam testing machine, gauged to the Watertown testing machine, in which the full log length is utilized with a cross section of 6 by 12 up to 8 by 16 inches, in order to establish the comparative value of beam-tests to those on the small test-pieces. It is expected that, on the average, 50 tests will be made on each tree, besides 4 or 5 beam-tests, or 250 tests for each species and site.

All due caution will be exercised to perfect and insure the accuracy of methods; and, besides the records, which are made directly in ink into permanent books, avoiding mistakes in copying, a series of photographs, exhibiting the character of the rupture, will assist in the ultimate study of the material, which is also preserved.

Such work as this, if done as indicated, and well done, will never need to be done over again. The results will become the standard, the world over. The strength and value of a given species or even stick will then no longer be a matter of opinion, but a question of established fact, and we will learn not only to apply our timbers to the use to which they are best adapted, but also what conditions produce required qualities, thus directing the consumer of present supplies and the forest grower of the future.

The American Association for the Advancement of Science, in its Section of Mechanics and Engineering, has created an Advisory Board to assist in securing improved methods, and the co-operation of other authorities will be welcomed to make this a truly national work.

So far the work has been confined to southern pines and oaks (which, thanks to the courtesy of the Louisville and Nashville Railroad Company, could be obtained free of transportation charges); the scant appropriations available, and other unfavorable conditions, making such limitation necessary.

The work will be extended and its progress pushed in proportion to appropriations made by Congress, which depend upon the interest which the work may arouse among those to be benefited by it.

FIRE-RESISTING MATERIALS.

TESTS were held on Oct. 15, in two buildings erected in a vacant lot on Park Street, Boston, Mass., for the purpose of demonstrating the efficiency of slow-burning construction, and also of various materials designed to retard free combustion. In addition to asbestos paper and ordinary lath and plaster, the materials manufactured by the following companies were used, being contributed by their representatives,—King's Windsor Cement Dry Mortar Company, Clinton Wire Cloth Company, New Jersey Wire Cloth Company, Magneso-Calcite Fire-Proof Company (who manufacture a fire-proof paper), Boston Fire-Proofing Company (who manufacture porous terra-cotta lumber), New York Eastern Plaster Board Company (manufacturers of cellular blocks of plaster of Paris mixed with fibrous vegetable matter), Stark, Edson, & Co. (manufacturers of albamural, which is a fire-proofing material in general appearance similar to kalsomine).

The buildings were constructed of two-inch tongued and grooved spruce plank placed upright and held by a grooved plate at the top. They were covered by flat plank roofs tinned on the upper side.

The larger building was 12 x 16, divided into four cells, with a fire door in each partition and one at the eastern end. The other building measured 12 x 12, being divided into three cells, and situated three feet from the larger building. Scuttles about two feet square were placed in the roof over each cell, but they were opened when the fire was started. The entrance at the front of each cell was provided with doors made of two-inch plank tinned on the edges and on the side toward the fire.

For the purpose of obtaining approximate temperatures in the buildings at the test, four links furnished by Mr. Morris Martin of the United States Electric Fire Alarm Company were hung on steel wire in the upper part of each cell, and the melting points of these links were stated to be as follows: lead, 626°; antimony, 842°; aluminum alloy, 1,292°; brass, 1,850°. Each of the cells was lined with fire-retarding material.

After the buildings had been thoroughly examined by those present, the fuel was placed in each cell, consisting of kiln-dried hickory wood piled to a depth of nearly four feet, and also piled to the depth of over five feet in the space between the two buildings. This wood was thoroughly wet with kerosene oil, and the fires were lighted at 12.21 P.M., simultaneously in each cell. Although the fires burned very fiercely, the buildings resisted the flames admirably, and it was considered that up to 1.30 P.M., or an hour and ten minutes after the fires were started, any burning of the buildings could have been extinguished with a pail of water.

The heat of the fire was too severe to allow near enough approach to make very careful or accurate observations of the interior until after the fire was extinguished by the fire department, who applied a hose stream upon the fires, beginning at 1.52 P.M. After the fires were extinguished, careful observations were taken of the conditions of each cell as it was at the time, and later further examinations of the floors were made after the ashes had been removed.

There were shutters placed upon the ends of the buildings. The wooden shutter covered with tin was somewhat injured and the wood badly charred. The shutter covered with one-eighth of an inch magneso-calcite, before the tin was applied, was in excellent condition. The fire doors in the partitions in the larger building all yielded during the fire. The immediate cause of their failure appeared to be the use of screws in attaching the hinges, and in this respect as well as others they all differed from what is known as the standard tin-covered fire doors, which require that all attachments to the doors shall be made by bolts and not by screws.

The doors in the partition were held in position, after the hinges gave way, by the mass of fuel piled on either side. The doors covered with asbestos paper or with magneso-calcite, before applying the tin, were somewhat distended by the gas generated by the heated wood, which could not escape readily, as was the case in the doors not covered except by the tin, where the gas could escape at the seams.

The doors at the front of the cells were tinned only on the edges and the side toward the fire, and were able to resist the heat of the fire for only about an hour, the cause of the failure in each case being the conduction of the heat along the lines of the screws at the hinges. These doors would undoubtedly have fallen earlier had they not been open a great portion of the time during the fire.

The heat of the fires apparently exceeded that of an ordinary burning building.

Among the principal facts established at this test, the committee conducting the experiment, consisting of C. J. H. Woodbury, C. M. Goddard, and D. L. Lord, wish to call attention to the great resistance to fire afforded by the solid plank construction, the walls being in themselves adequate to prevent the spread of a fire until it has reached a quite large extent; and such construction should in many instances be used in place of ordinary joisted partition. While it is not claimed that such solid plank partitions are equal to a brick division in resistance to fire, yet there are many places where the difficulty of supporting a brick wall would render such a division out of the question, and yet a plank partition could be placed as readily as one supported on joist.

The porous terra-cotta lumber and the Eastern plaster board both presented a high resistance to heat, and were unaffected by exposure to the fires.

The secure bond of the wire lath, especially when re enforced by band iron, proved the value of this material in securely holding plasters when exposed to fire.

The magneso-calcite proved its value for re-enforcing tinned fire doors and shutters, resisting the fire, and yielding only when the material to which it was attached fell.

The King's Windsor cement dry mortar resisted the fire in a most efficient manner when the support of the back remained, and, moreover, did not crumble as a result of heat or of streams of water played upon it when hot, as was the case with the ordinary lime mortar.

NOTES AND NEWS.

THE difficulty of keeping Irish potatoes in edible condition after March 1 is well known to Southern housekeepers, farmers, and merchants. Professor Schribaux of the National College of Agriculture of France has recently devised a very simple, cheap, and successful method by which he has been able to preserve potatoes in edible condition for over a year and a half. This process has been adopted by the French government for preserving potatoes for the army. The French Minister of Agriculture publishes the details of the process in the official *Bulletin du Ministère de l'Agriculture* for March, 1891. The following is a translation of the essential part of the scheme. The method of preservation consists in plunging the tubers, before storing them away, for ten hours into a two per cent solution of commercial sulphuric acid in water, two parts of acid to 100 parts of water. The acid penetrates the eyes to the depth of about one-fortieth of an inch, which serves to destroy their sprouting power; it does not have any appreciable effect upon the skin of the potatoes. After remaining in the liquid ten hours the tubers must be thoroughly dried before storing away. The same liquid may be used any number of times with equally good results. A barrel or tank of any kind will do for the treatment. The acid is so dilute it does not affect the wood. Chemical analysis shows that potatoes treated by this process are as nutritious and healthful after eighteen months as when freshly dug; but they are of course worthless for planting. Attention is called to this method by Gerald McCarthy, N. C. Experiment Station, Raleigh.

— Dr. B. A. Gould, president of the American Metrological Society, writes from Germany that at the quinquennial session of the Geographical International Congress held in Berne Aug. 10–17 there were about 280 delegates and representatives from all countries. At this congress was passed the following resolution on Aug. 14: "The Geographical Congress entreats Englishmen of science to desist in future from the use of their ancient units of weight and measure in scientific and technical publications, and to employ those of the metric system only." This resolution was passed with immense enthusiasm; the applause and cheering lasting for nearly five minutes, and the vote was unanimous. In connection with this the American Metrological Society has prepared a petition asking Congress to pass the following act: "That on and after July 1, 1893, the metric system of weights and measures authorized by the act of Congress approved July 28, 1866, shall be used exclusively in the customs service in the United States." This petition they desire to circulate widely among those desiring to sign it, and they ask each signer to mail it to his representative in Congress. The American Metrological Society has prepared a simple chart of the metric system which, for educational purposes, it will mail to any one asking for it for 10 cents in stamps. Address Secretary of American Metrological Society, No. 41 East 49th Street, New York City. Copies of the petition can be had at the same address.

— Dr. Wiesendenger describes a new method of producing anæsthesia by the application of cold, the characteristic feature of which is that it is not the cold-producing agent which touches the desired part, but a metallic tube or chamber which is cooled by carbonic acid. The cold may, according to the requirements of the case, be regulated from the temperature of cold water to one sufficiently low to cauterize. The first symptom of this artificial cold is anæmia of the cellular tissue, producing a slight sensation of burning, which is followed by anæsthesia, which lasts from one to two minutes and then disappears without any ill effects. As the instrument may be manufactured of almost any shape, it is evident that this new method may be used for a variety of purposes. The simple turning of a tap will regulate the stream of carbonic acid to any degree of temperature down to four degrees Fahrenheit. No moisture is produced. In using this cold for the purpose of cauterizing the surgeon has the advantage of producing anæsthesia at the same time. When applying it to any of the internal cavities, such as the mouth, it is necessary to have the parts carefully dried, as the tissues would otherwise adhere to the instrument. Dr. Kummel applied the method, according to *The Lancet*, in the case of a boy in the Maria Hospital at Hamburg with such complete success that the boy looked on without moving a muscle while a deep incision of twelve centimetres in length was made in his thigh.

— The hospice of the great St. Bernard (7,609 feet above the sea-level) is said to have been founded A.D. 962 by St. Bernard of Menthon, while, according to some authorities, it rose a century earlier, under Charlemagne. Neither saint nor emperor is likely to make good his claim, as the archives of the hospice have been completely destroyed in two successive conflagrations. But, like other Christian institutions, it had undoubtedly a pagan predecessor. The Romans on the self-same spot built a temple to the Pennine Jove, and that, in turn, occupied the site of a still earlier shrine of prehistoric antiquity. The truth is, the Alpine passes were in common use from the remotest ages — the Christian world treading the same route which had been trodden by the Romans, who also availed themselves of the track made by the aborigines. At its highest point the tutelary deity had his place of worship, and this was served by the local priesthood, who rendered assistance to the distressed or ailing traveller and received votive tributes in return for its good offices. The existence of a temple of Jupiter on the spot, with its staff of priests, is well known; and the relics that have turned up near it attest its uses to have been similar to those of the present hospice. A discovery of importance, says *The Lancet*, has just been made in its vicinity — a bronze statue in excellent preservation of Jupiter himself. Its artistic value is very great; its height, forty centimetres. At the same time other treasure-trove was brought to the surface, including a number of medals and a statuette of a lion measuring sixteen centimetres, also of fine workmanship. These are now the property of the monks, and will attract to the hospice a public more able to keep them in funds than the proper recipients of their kindness. Sad to relate, the revenues of the monastery, heavily drawn upon by the travellers (from 16,000 to 20,000 annually) who throw themselves on its bounty, are diminishing, the contributions left by these comfortably accommodated guests being miserably below what, in the majority of cases, they can afford. The heroism of the monks should be remembered by the well-to-do holiday visitor. They begin their career at the age of eighteen or nineteen. After fifteen years' service the severe climate has made old men of them. For eight or nine months out of the twelve they see none but the poorest wayfarers, when the cold is intense, the snow lying deep, the danger from storms incessant and fearful. Their sole companions are the dogs, whose keen scent has guided them to the snow wreath under which the buried traveller has so often been rescued and brought to life — dogs like that noble fellow "Barry," who saved forty men in his time, and who now, carefully stuffed, adorns the museum at Bern.

— The Brooklyn Institute announces courses of lectures on Geology and Archæology, by Professor Franklin W. Hooper. The separate courses will be devoted to physiography, the earth's structure, the earth's history, glaciers of the age of ice, local geology, and archæology. Each of the lectures will be illustrated by sixty or more lantern photographs and by collections of geological or archæological specimens. The courses are subject to alteration to meet special requirements. The Institute will conduct these courses of lectures on the so-called "University Extension" plan, under the title of "Institute Extension Lectures." Each lecture will be preceded by a conference on the subject of the previous lecture. A syllabus of each course of lectures, together with directions for reading and study, will be provided. Those who desire may present themselves for examination at the close of a course by giving ten days' notice. Certificates will be issued by the Institute to those who pass a satisfactory examination. Arrangements for courses may be made with the Institute. The lectures may be given in the rooms occupied by the Institute, or at any convenient point in Brooklyn and the immediate vicinity. The Institute Extension Lectures are independent of the other work at the Institute, and special course tickets are necessary for admission to them.

— The report of Arthur Winslow, State geologist of Missouri, shows that, during the month of October, inspections of iron ore deposits have been made in Randolph, Monroe, Benton, Henry, Hickory, Franklin, Reynolds, Crawford, and Dent Counties. Inspections of lead and zinc deposits have been made in Pettis, Benton, Hickory, Camden, Miller, Cole, Osage, Franklin, and Reynolds Counties. Inspections of coal beds have been made in Cooper, Saline, and Lafayette Counties, and surveys have been made for the purpose of constructing a model of an important coal deposit in the first named county. Detailed mapping has been prosecuted in Henry, Benton, and St. Francois Counties, and over 230 square miles have been covered. For outlining the areas of the crystalline rocks examinations have been made of an area covering about 300 square miles in Reynolds and Iron Counties, and the areas of the geological formations in portions of six townships in Greene and Polk Counties have similarly been mapped. Examinations of important clays of the State have been continued and additional experimental tests on sixteen samples of such are now completed. In the office much has been done on the preliminary report on the coal deposits of the State, which will be placed in the printer's hands this month. Work on the preparation of the reports on the mineral waters and on the paleontology of the State has also progressed well. Further, much draughting has been done of illustrations to accompany reports of detailed maps and sections. Engraving of these maps has been started and can now be continued uninterruptedly with the supply of maps which have been prepared during the past months. Bulletin No. 5 has been distributed.

— No sooner is one antiseptic chemical rejected by some disappointed disciple of antisepticism, says the *Medical Press*, than he is greeted by a new chemical possessing all the virtues and free from all the vices of its predecessor. The list commenced with the peerless carbolic acid and its many preparations, all of which made way for the ill-smelling iodoform or the poisonous corrosive sublimate; these in turn were pushed aside for newer and more popular remedies, until "ariostol" claimed notice; still, however, the search goes on, and of course the demand begets a supply. Dr. Berlioz now presents to the Parisian Academy of Medicine a new chemical which already has proven itself worthy, if we accept the statements of its advocates, of general recognition as the best of antiseptics. He names it "microcidine," a name which it is hardly entitled to, seeing that its germicide powers are inferior to those of corrosive sublimate. According to Professor Polaillon, the new drug is not a definite chemical compound, but rather a mixture of B naphthol and hydroxylate of sodium. This new product is soluble in three times its weight of cold water, the solution being of a brown color, which disappears on dilution. The chief advantages claimed for this, the latest of antiseptics, is its slight cost, and that it is non-poisonous.

— A new use has been found for waste glass. Any fragments of broken glass of various colors are mixed together, after having been broken to a suitable size; they are then placed in moulds lined with silica, talc, or some other resisting material, and fired. A coherent mass is produced which can be dressed and cut into blocks, which are, of course, irregularly colored. Such blocks may be used as artificial marble. The blocks are usually rough on one side, owing perhaps to incomplete fusion; this gives a surface which is admirably adapted for causing them, especially if they are slab-like in form, to adhere to walls with the addition of a little mortar. Fine decorative effects can thus be produced. Designs in relief can be obtained by pressure while the block or slab is still plastic. If a suitable mould be prepared with movable partitions, then pieces of glass can be arranged in such a way that, upon firing, a very effective "stained-glass" window is produced, the necessity of using "leading," as in the ordinary way, being thus obviated.

— The other day, Mr. Flinders Petrie delivered at the Owens College, Manchester, a most interesting address on exploration in Egypt which is reported in *Nature*. It had been thought, he said, that the immense mounds of rubbish indicating the sites of towns had been made on purpose, but they resulted from the natural decay of the mud-brick buildings. These heaps of ruined walls and earth and potsherds rose even to eighty feet high in some places; but other ancient sites were much less imposing, and might even not attract notice on the open desert. The higher the mound the longer the place had been inhabited; and if the surface was of a late period, the earlier parts, which were most needed, were under such a depth of rubbish as to be practically inaccessible. Much could be known at first sight; and prospecting had now become as scientific a matter in antiquities as in geology. Knowing, by a glance at the sherds on the top, what was the latest period of occupation of the site, and knowing the usual rate of accumulation of a mud-brick town — about five feet in a century — we could guess how far back the bottom of the mound must be dated. Other remains had different indications. If in the midst of a great mound there was a wide flat crater, that was probably the temple site, surrounded by houses which had accumulated high on all sides of it. Speaking of the results of exploration, Mr. Petrie said that we now realized what the course of the arts had been in Egypt. In the earliest days yet known to us — about 4000 B.C. — we found great skill in executing accurate and massive stonework, such skill as had hardly ever been exceeded. We found elaborate tools used, jewelled saws and tubular drills. We saw the pictorial arts as fully developed as they were for thousands of years later. But what led up to this we were still feeling for.

— Dr. H. von Wlislocki, as we learn from *Nature*, has published a capital paper on the handicrafts of Hungarian gypsies, whom he has had many opportunities of observing. If we may judge from the illustrations, they have a considerable aptitude for design. In the summer they make bottles out of pumpkins, which they decorate with various drawings. On each bottle the space is divided into four zones, crosses being cut into the uppermost zone, serpents into the second one, circles into the third, and zigzag lines into the fourth. The crosses mean "May you be happy!"; the serpents, "May you have no enemies!"; the circles, "May you always have money!"; the zigzag lines, "May you be healthy!" Brandy is kept in the bottles; and when a guest is received, the first gypsy who drinks says, "May you be happy!"; the second, "May you have no enemies!" — and so on. Pretty walking-sticks are also among the things made by the Hungarian gypsies. On the top of one of those sketched in the article two female heads are admirably carved. These represent Ana, the Queen of the Keschalyis, or forest fairies, who dwell among the mountains, where they sit — three being always together — on rocks, spreading out their long hair over the valleys, thus giving rise to mists. Queen Ana lives in a black palace, and sometimes wanders over the world in the form of a frog. Frogs, toads, and serpents are her favorite animals. When she meets any one in her natural form, she exclaims "Ana!", which means "Bring!" Should the person understand the cry and bring a frog, a toad, or a serpent, he is richly rewarded. If he fails to do so, he is either killed with a piece of a rock, or struck by some terrible malady.

— The belief is quite general among strawberry growers that imperfect flowered varieties are less liable to injury by frost than perfect, or staminate flowered sorts. Two heavy frosts occurred on May 5 and 17, 1891, which did much injury, as all varieties were then in bloom. The large number of varieties on trial at the Ohio Agricultural Station made it possible to test the accuracy of the belief above stated. The Enhance and Parker Earl, both varieties having perfect flowers, escaped with but little more injury than the imperfect flowered sorts, but aside from these exceptions, the varieties of this class suffered far more injury than those having imperfect flowers. These varieties are later in blooming than most others, and possibly they are uncommonly hardy, but it is safe to make the generalization that perfect flowered sorts are less hardy when in bloom than those having imperfect flowers.

— Some interesting facts about the tastes and manners of London board-school children were brought out at a meeting of the workers of the Children's Happy Evenings Association, held at the house of Mrs. Moberley Bell, who will in future act as honorary secretary of the Association. According to *The Educational Times*, the room where children gather to listen to fairy tales, play quiet games, and do needlework is more popular than the room given over to romping and noisy games. Painting is the favorite occupation, and with the paint boxes provided by the Association the children delight in coloring the illustrated advertisements from daily and weekly papers—one lady worker remarking that fashion advertisements were first favorites. The experience of the workers seemed to be that it was quite possible for the boys and girls to dance and play together, and that the effect was beneficial to both, provided the staff of helpers was sufficiently large.

— In the *Revue Agricole*, published in Mauritius, M. A. Daruty de Grandpré gives an account of his attempts to raise sugar-cane from seeds. The seeds, according to *Nature*, were sent from Barbados by the Governor in March, 1890. M. de Grandpré planted them with the greatest care, and after five days was fortunate enough to obtain five minute seedlings out of the hundred seeds used. The young plants he raised did not all prove equally vigorous, and he was able to save only one, which, at the time when his report was written, had formed a fine clump of twenty shoots with long ribbon leaves. "I believe," he says, "that we may with reason cherish the most sanguine hopes from from the propagation of sugar-cane from seeds — more especially if we try an intelligent system of cross-fertilization of the varieties we possess — rather than by planting cuttings, which maintain without appreciable alteration the respective characteristics of the parent plants. Thus we shall be able to supplement the weak points in our best varieties of sugar-cane by crossing them with others which are remarkable for the qualities it is intended to infuse into them, and we shall moreover obtain, by a process of selection, a cane rich in saccharine matter, which will enable us to compete successfully against the highly improved sugar-beet."

— The Association of Colleges in New England, impressed with the real unity of interest and the need of mutual sympathy and help throughout the different grades of public education, invites the attention of the public to the following changes in the programme of New England grammar schools which it recommends for gradual adoption: (1) The introduction of elementary natural history into the earlier years of the programme as a substantial subject, to be taught by demonstrations and practical exercises rather than from books. (2) The introduction of elementary physics into the later years of the programme as a substantial subject, to be taught by the experimental or laboratory method, and to include exact weighing and measuring by the pupils themselves. (3) The introduction of elementary algebra at an age not later than twelve years. (4) The introduction of elementary plane geometry at an age not later than thirteen years. (5) The offering of opportunity to study French, or German, or Latin, or any two of these languages, from and after the age of ten years. In order to make room in the programme for these new subjects the Association recommends that the time allotted to arithmetic, geography, and English grammar be reduced to whatever extent may be necessary. The Association makes these recommendations in the interest of the public school system as a whole; but most of them are offered more particularly in the interest of those children whose education is not to be continued beyond the grammar school. At the thirty-fifth annual meeting of the Association, held at Brown University, Nov. 5–6, it was voted that these suggested changes be transmitted to the various faculties for their consideration and for action by the Association next year.

— A case which occurred in Sussex illustrates well the manifold sources from which arsenical poisoning may be derived. A man named Wesley, we learn from the *British Medical Journal*, died with symptoms of gastro-enteritis, while five other people in the family were taken seriously ill. It transpired that they had all partaken of some home-made gooseberry wine, and that this had been stored in a cask previously used for the reception of a certain weed-killer largely composed of arsenic, and there could be but little doubt that the poisoning was due to the arsenic. A case very similar to this occurred some years ago, when a man lost his life by drinking beer out of a pot which had been cleansed with a patent cleansing fluid containing arsenic, and there is also the well-known wholesale poisoning at an industrial school, when over 300 children were poisoned by some water being added to their morning milk which had been drawn from a tank recently cleansed of fur by a solution of arsenite of soda. Happily on that occasion no fatal result occurred; but the result was not so fortunate in the Bradford peppermint-lozenges case, when out of 200 sufferers seventeen died; here arsenic had been used to adulterate the lozenges in mistake for sulphate of lime. Another case of accidental poisoning will doubtless be fresh in the recollection of our readers, when the poison was absorbed through the skin; we refer to the two infants who lost their lives through the use of a violet powder into the composition of which arsenic had entered. The lesson to be learned from the recent and other cases is that cleansing liquids are very dangerous things.

— The Scientific Alliance of New York, recently organized, includes the New York Academy of Sciences, the Torrey Botanical Club, the New York Microscopical Society, the Linnæan Society of New York, the New York Mineralogical Club, and the New York Mathematical Society. The secretary of the council is Dr. N. L. Britton of Columbia College, to whose efforts the new system is principally credited. Instead of announcements separately issued, the members of the different societies receive in a single bulletin a comprehensive statement of the proposed meetings of each for the month, and as persons frequently are members of several of the societies the convenience of the direct comparison which is provided in dates and subjects is at once appreciated. A folding card bulletin, as easy of reference as a calendar, gives one space to the notices of each society, and one of the spaces contains a general chronological index. An additional fold is given in any issue for special announcements when required. The highly approved plan of unity of measures thus in operation is similar in principle to that of Burlington House, London, and if succeeding in the manner expected from present favorable circumstances, the New York Scientific Alliance will be established at some future day in a building of its own, containing many united collections in one great exhibition.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

PROFESSOR WILLIAM FERREL.

WILLIAM FERREL was born in Pennsylvania, 1817. In 1856, at the age of thirty-nine, he began a series of studies in meteorology, which, in their more finished form, in later years gave a new aspect to this science, and placed him at the time of his death, Sept. 18, 1891, at the front of American meteorologists. His work was always quietly done, never with any attempt at the conversion of the great public, or almost with indifference to the attitude of the scientific public regarding his beliefs; but with the patient conviction that he was working in the right direction and that his theories would in time receive general acceptance. Towards the close of his life, this happy end was reached, as far as the better informed meteorologists of the world were concerned, and in Europe as well as in this country, Ferrel was regarded as the leader in the methods of mathematical meteorology; not that others who followed in his paths did not exceed him in completeness of demonstrations, but that the methods which he introduced into the science were essentially the same as those by which his successors carried it further. A comprehensive narrative of his life is given in the *American Meteorological Journal* for February, 1888, by Alexander McAdie of the Weather Bureau, and a list of his publications in the same journal for October last; I shall therefore here only touch on what seems to me highly characteristic of his work, and of the revolution that it produced in scientific meteorology.

Unscientific meteorology, such as was current before Ferrel's work reformed it, cannot yet be said to be excluded from popular acceptance. We still find writers who take Maury as their authority, following his antiquated views, quite unaware that they are thirty years behind the times. I do not wish to detract in the least from the deserved reputation gained by Maury for his persevering study of the winds and currents of the ocean; for the great incentive that he gave to ship-masters to become observers and bring home a careful record of their observations. The tabulation of the facts thus gathered formed the basis of wind charts for the several oceans, first produced in this country, and closely followed by the hydrographers of many foreign nations. It is on this collection of facts that Maury's reputation rests secure; and not on his theories, for they were essentially wrong and are now practically laid aside. Unfortunately for his success in this department of science, Maury seems not to have been well equipped with knowledge of physics and mathematics, and in his ignorance of these subjects he was led into serious errors as to the motions of the winds. Those errors have been considered by various writers, but by none earlier or more effectively than by Ferrel, who, in 1856, published an essay in the Nashville *Journal of Medicine*, an essay prompted by the insufficiency of Maury's theories. It is not necessary to enter here into an exposition of Ferrel's theory; those who wish to study it may find its fullest statement in his latest work, a "Popular Treatise on the Winds," published in 1889. Some statement of these theories may be found in *Science*, ix., 1887, 539; and xv., 1890, 142. But it may be briefly said that the difference between Maury's theory and Ferrel's is as the difference between darkness and light.

Maury thought the return current from the poles was in this hemisphere an east-north-east wind: Ferrel showed that it is a west-north-west wind. Maury was not alone in thinking that the polar return current flowed in our latitudes from the north-east. Dove, the leading German meteorologist of the middle decades of this century, had the same idea, and, I think, at an earlier date than Maury. According to Dove, the alternation of north-east and south-west winds that we feel with the passage of our storms centres is simply the contest of the polar and equatorial currents, of which first one and then the other reach the surface of the earth. This view, embodying the idea of the north-east-south-west course of the polar return current, may be said to have held an accepted place in meteorology at the time when Ferrel prepared his first essay on the subject. But for those who have followed Ferrel's work, the north-east return current has no existence. His reasons for giving this return current a north-west source are simple and ample; and for those who do not share this view, there is a large fact in nature which cannot be explained; namely, the low pressure about the North Pole; a similar arrangement prevailing in the Southern Hemisphere, where the return current comes from the south-west.

This seems to be a small matter. It is a slight change to make in words, to say that the return polar current comes from the north-west, not from the north-east: and truly, if this were all that could be said, it would not be a great affair. But if the reader will examine the question carefully, and study the development of our knowledge of the winds, he will soon be convinced that the introduction of Ferrel's idea as to the course of the polar return current and the explanation of the low pressure that is bound up with it, marks the introduction of rational physical principles into this department of meteorology. This change came at a time when the physical study of meteorology was a rare thing. Look, for example, at Schmid's "Meteorologie" of 1860, a voluminous treatise, well representing the condition of the science then; compare with it Spring's "Lehrbuch" of 1885, in which the science is presented in the manner introduced by Ferrel. The difference is that between statistical, inductive methods, and fully expanded logical methods that utilize all means of inquiry. The science has become a new thing by this change; would that meteorologists had as greatly changed and were not still so content to read instruments and count up totals and means.

If we were to search Ferrel's writings for the most important principle introduced by him into the study of meteorology, it would be found in the deflective force arising from the earth's rotation, by which all bodies moving on the earth's surface tend to turn to the right in this hemisphere, but to the left in the southern. It is curious in reading over the general run of meteorological essays to notice how inadequately the action of this force is considered. In the first place, it is too commonly said to act only on meridional motions; that is, to make a poleward motion run ahead of its initial meridian, or an equatorward motion fall behind; but to have no effect on a motion to the east or west. This is incorrect, for, as Ferrel shows, the deflective force is independent of the azimuth of motion, and varies only with the velocity of motion and the sine of the latitude. In this he was preceded by others, who discussed the mathematical aspects of the question; but if we except the overlooked article of Tracy, no one before Ferrel correctly introduced the action of the deflective force into meteorology. It is not simply that a wind tends to turn aside from the gradient, as may be seem by the most elementary inpection of our weather maps; but that, in thus turning aside, it reacts on the distribution of pressure by which its motion is caused, and produces a very significant re-arrangement of pressures in some cases. This was first demonstrated by Ferrel; and if the student wishes to appreciate the conditions under which the winds move, he should follow this subject out to its end. The most conspicuous effect of the re-arrangement of pressures in this manner is the reduction of the polar high pressures, such as would exist if determined by low temperature alone, into low pressures: for, on account of the earth's rotation, the whole system of terrestrial winds in temperate and frigid latitudes runs in a great whirl around the poles from west to east; and the centrifugal force thus developed in excess of that characterizing the rotation of the earth itself, suffices to withhold so much air from the polar regions that the anticipated high pressure due to low temperature cannot occur there: the air thus withheld from the polar regions forms a broad belt of high pressure around the tropics. The importance of this even in elementary teaching must be apparent; for when a teacher tells his class that the general winds flow because the difference of temperature between the equator and the poles establishes a convectional circulation, the class has a right to ask why the region of low temperature is not the region of high pressure, as it should be in a convectional circulation. No sufficient answer to this significant question is to be found in any text-book in our language, except Ferrel's "Popular Treatise." Not only so; some of the most eminent meteorologists give no particular attention to this aspect of the question. For example, in the recent "Report on the Meteorology of the Challenger Expedition," the most beautifully illustrated of any meteorological work ever published, Buchan passes over the matter without alluding to Ferrel's explanation of it, and without giving any adequate explanation of it himself. In Germany there is a much better appreciation of the nature of the case, as far as it is represented by the investigations of mathematicians and the discussions in recent text-books. The contrast between the attitude of the conservative British and the progressive German schools may indeed be taken as indicating the difference between the older and the more modern status of meteorology; the division between the two being on the lines marked out by Ferrel. Certainly, when we find that the general distribution of atmospheric pressure, the general direction of the greater part of the atmospheric circulation and the general velocity of its motion all depend on the deflective forces arising from the earth's rotation, it is not unfair to claim for them and for the investigator who first properly introduced them a large share of credit in the recent advances of meteorology. It is the same with cyclones; those of the torrid regions, where the deflective force is small, present illustrations of distributions of pressure and circulation of wind dependent chiefly on differences of temperature and local centrifugal force; but in temperate latitudes, where the sine of the latitude is of a considerable value, the low pressure of the central part of the cyclonic storms is in great part the product of outward deflective force that accompanies the motion of the winds Finally, even in the small vorticular whirls of tornadoes, the deflective force has its effect; not directly, as in the case with cyclones proper, but indirectly: the tornado whirls around because it is developed in a whirling cyclone, and the cyclone turns because it is developed on a rotating earth. Indeed, in following through Ferrel's admirable theory of tornadoes, the only theory of tornadoes worthy of a name, it is made clear that if the deflective force of the earth's rotation were not, indirectly at least, communicated to the tornado, its violence would be greatly reduced, perhaps to the degree of rendering it nearly harmless.

The introduction of a general principle into a science, whereby a variety of apparently independent facts are found to be bound together by a comparatively simple relation, is in itself a great contribution to knowledge. The grand views of the correlations that connect all the winds of the world that are gained through Ferrel's essays repay the effort needed to study them out to the point of clear understanding; not that the essays are obscure or unnecessarily complex, but that their reading involves a rather clear knowledge of physics and mechanics, not to speak of mathematics, and a careful following of close reasoning from premises to conclusions.

No just appreciation of Ferrel's simple life and broad scientific work can be given in a brief article. His work in meteorology is much more varied than may be inferred from the emphasis here given to a single one of the leading principles that he followed. The others will be found by the faithful students of his books. His studies in other subjects than meteorology are of sufficient importance to deserve a separate notice. He was far enough advanced in astronomy, while employed in our Nautical Almanac office, to give new understanding to one of the puzzles of the sky; an unaccounted acceleration of the moon's motion was explained by him as a result of a retardation of the earth's rotation, caused by the action of the tides. The interaction of the lunar and terrestrial tides was also perceived, and when in the Coast Survey office in Washington, the calculation of tide-tables at our Atlantic ports was a subject of advanced study. A tide-predicting machine was then devised, by which the labor of thirty or forty men is now saved. Later in the Signal Office, Ferrel prepared his report on "Recent Advances in Meteorology," and gave lectures to the lieutenants on duty there, the substance of these lectures being now published in the "Popular Treatise on the Winds," referred to above.

Ferrel's simple manner of living kept him apart from the world about him; he had warm friends, but they were comparatively few. These few unite in feeling that it was a privilege to know such a man; modest, unassuming, even humble in his ways; yet with an insight into the truths of nature that goes only with rare genius. He was one of the small number of men in the world who not only advance the limits of knowledge, but who turn the search for it into new courses. It is safe to say that while he must already be regarded as the most eminent meteorologist of our country, the true measure of his eminence will be better recognized when those who follow the science that he enlarged come to appreciate more fully what he did for it.

W. M. D.

PROFESSOR JOSEPH LEIDY: HIS LABORS IN THE FIELD OF VERTEBRATE ANATOMY.[1]

We hear it said that at no time have the conditions for intellectual attainment been so favorable as in the days of Athenian supremacy. This may be true for communities, but not for individuals. Surely the atmosphere of Philadelphia from 1823 to 1891 favored greatness in science, else there is no connection between the man and his environment. Is it not a truth that it only needs the man to come forward to claim favoring conditions, to insist upon them as his own, to have another like Joseph Leidy to be bred among us? A man to whom questions of birth and of patronage were as nothing; one with a common school education and without the subsequent advantages of training under distinguished masters; one to whom all things required for his well-being appeared to come like the beneficent forces of nature until we are apt to lose sight of the will and of the steadfast purpose that directed them. He was never

> "limited and vexed
> By a divided and delusive aim,"

but, fixed and invariable in his methods, he completed a unique career.

He dedicated himself early to anatomy, and it is about this science as a central stem that all his labors cluster.

Signs of immaturity are evident in the early labors of most men. But this was not the case with Leidy. His first paper, entitled, "Notes on the White Pond in New Jersey" (Proc. Phil. Acad. Nat. Sci., 1847) exhibited the same clear observation and lucidity of statement which characterize his subsequent writings. The earliest of his anatomical papers ("On the Fossil Horse of America," Proc. Phil. Acad. Nat. Sci., 1847, 262) was in no respect inferior to any of his numerous records in the literature of paleontology of North America. The word growth used in respect to him is inappropriate. In the best sense of the word he never grew. Rather, like Bichat, he simply unfolded the native resources which lay innate within him.

For his graduating thesis in medicine he treated of the eye in vertebrate animals. This essay has not been published. In his twenty-second year, namely, July 29, 1845, he was elected a member of the academy, and from this date to that of his election to the chair of anatomy in the University of Pennsylvania, eight years later, his communications were in the main devoted to the structure and properties of the vertebrates. In this interval his industry was great, for he was actively engaged at the same time in teaching, and in assisting Professor W. E. Hoone in his anatomical work, and Professor George B. Wood in dissecting and mounting pathological specimens. He described the retention of the intermaxillary suture in the skull of a New Hollander (Proc. Phil. Acad. Nat. Sci., 1847), also one on the same bodies in the boa constrictor resembling the Pacinian corpuscles (Proc. Phil. Acad. Nat. Sci., 1848, 27). He wrote a paper on the existence of the intermaxillary bone in the embryo of the human subject of the tenth week (Proc. Phil. Acad. Nat. Sci., 1848, 45).

[1] Read at a special meeting of the Philadelphia Academy of Natural Sciences, May 5, 1891, by Harrison Allen, M.D.

Remarkable instances of preservation of organized animal matter were reported by him in 1847 (Proc. Phil. Acad. Nat. Sci., 313) on the films and cartilaginous structures in the extinct genera *Basilosaurus* and *Megalonyx*, the former a reptile of the rocene and the latter a mammal of the pliocene age. The vertebræ of *Basilosaurus* retained tissue which when burnt gave out animal odor. Fibrous membranes taken from one of the bones of *Megalonyx* exhibited many of the characteristics of recent membrane; in the articular cartilages the corpuscles were well preserved and distinct. It was held that under favoring conditions the cartilaginous and fibrous tissue might be preserved for an indefinite period.

In 1848 (Proc. Phil. Acad. Sci., 116) Dr. Leidy read remarks on the development of the Purkinjean corpuscles in bone; on the intimate structure of articular cartilage, and on the arrangement of aveolar sheath of muscular fascicute and its relation to tendon.

Cartilage was found to possess numbers of fine, transparent filaments, nearly uniform in thickness, having an average measurement of $\frac{1}{25000}$ of an inch. Hunter had claimed this fibrilation, but without the aid of the microscope it cannot be demonstrated. This cannot be said to be a prior claim. Professor George A. Piersol has kindly informed me that Dr. Leidy was the first to make the announcement of a fact now accepted. Kolliler was inclined to regard the appearance as pathological. The fibrillar nature of the matrix of all dense connective tissue, including cartilage and bone, is now universally recognized. The comments upon the arrangement of the aveolar sheath of muscular fascicute were to the effect that "the filaments of fibrous tissue cross each other diagonally around the muscular fascicute, forming a double spiral extensive sheath. When the filaments reach the rounded extremities of the fascicute they become straight and in this manner conjoin with the tendinous filaments originating at the extremities of the muscular fibres. The importance of this arrangement can be readily understood, from the diagonally crossing of the aveolar filaments, comparatively inelastic in themselves, the sheath is rendered elastic, thus permitting the muscle fibres freely to move without their action being interfered with."

Dr. Leidy was in the habit of introducing these comments in his lectures when speaking of the function of fibres depending upon their position to each other rather than upon differences in composition.

In 1849 (Am. Journ. of the Med. Sci.) Dr. Leidy announced a plan of the construction of the liver. He assumed that the follicul form of the liver in insects represented the plan of the primitive liver of the human embryo. The subsequent changes which lead up to the complex system of interlacing of tubules with their linings of biliary cells was the result of the blind end of the follicle undergoing subdivision by branching, each of the branches being lined with the cells and the mouths of the now open tubules, freely communicating with each other. This scheme was the most philosophical of any hypothesis previously proposed to account for the intricacy of the minute anatomy of the liver; it was accepted at once by the scientific world, and is itself an answer to the criticism sometimes made upon Dr. Leidy's labors, that they are purely descriptive. The evolution of the system of glands appended to the alimentary canal was distinctly set forth by Leidy in this paper. Since the relations of the liver as a blood-making and an excretory organ have been better defined, other hypotheses than that of Leidy have been proposed to elucidate its morphology.

But the latest expressions on the subject show an evidence of the reindorsement of the original statements.

In 1850 (Proc. Phil. Acad. Nat. Sci., 201) Dr. Leidy performed some experiments upon the transplantation of cancer. Taking several fragments of a cancerous tumor from a human subject he inserted them beneath the skin of living frogs. After an interval of five months had elapsed the frogs were killed and the localities in which the sections had been inserted were examined. In all but one instance they were found to be living and united to the host by vascular attachments. The characteristic cancer cells, however, had in great part disappeared. Dr. Leidy believed that similar experiments on warm-blooded animals might increase the number of viable cancerous elements. The transplantation of tissue from one animal to another was not novel, but the facts of these experiments proved that cancer might be inoculable, — a statement which was novel, and has been disputed since. The observation was in the line of most important research, and the recent experiments embracing the successful transfer of the human hypertrophied thyroid body from the neck to the abdomen of the same individual have been essayed with important practical results. They again demonstrate that Dr. Leidy's mind was not one limited merely to the line of description. At the time of these experiments Dr. Leidy was conducting a course of physiological instructions to medical students. No doubt remains that had he chosen physiology as a branch of research that he would have been signally successful.

In 1852, Dr. Leidy created from the species *Hippopotamus liberiensis*, Morton, a new genus, *Chœrodes*, which was founded upon the skeleton of a young individual. In the *Journal of the Philadelphia Academy* for 1850–54 this form was renamed *Chœropsis*, since *Chœrodes* was found to be previously assigned to a genus of insects. Abundant material of the adult has since been received in Paris and made the basis of an elaborate memoir by Alphonse Milne-Edwards, who has confirmed Leidy's diagnosis in every particular.

Opinions have differed widely as to the nature of dental caries. One set of observers claimed that it was due to vital or general conditions affecting the economy; another insisted that the disease was due to forces acting entirely from without. Since the bacteriological method of research has been introduced into medicine this difference of opinion no longer exists, for all agree that the statement last made is the correct one. Dr. Leidy in 1870 (Proc. Phil. Acad. Nat. Sci., 133) demonstrated in the subject of an old man that a single tooth remaining in the lower jaw was free from caries owing to the fact that it was imbedded in the bone. He thus demonstrated that caries was caused by extraneous conditions, for the disease was controlled by vital states of the individual, it was unreasonable to infer that they would not long before have attacked and destroyed the tooth that had so long remained in the jaw. This fertile suggestion anticipated the discovery of the bacillar origin of dental caries made by one of his pupils, Professor Miller of Berlin, several years afterward. The announcement of a new species of fossil horse and of a new species of Pæbrotherium, in 1847, brought to Dr. Leidy a reputation for acumen in the study of fragments of skeletons, and the study of the treasures of fossil remains in all sections of our country soon controlled his energies. While this work is strictly anatomical, its relations are in the main with geology; it is so vast in quantity that no attempt can be made here to discuss it, even if your speaker were competent to do so. This much can be said in dwelling upon his qualifications as an anatomist, so far as I know, there is but one instance of his having made an error in statement.[1] Attempts to protect from error often go with timidity, if they are not due to it. But in Leidy's case it was not over caution that saved him from error, but too correct primal impressions of the objects he studied. His powers of application were amazing, and the correctness of his conclusions was due to swiftly drawn deductions from the existing premises, and not to surmises or to feats of the imagination. In illustration of his ability may be mentioned his discovery of *Uineatherium*, — this genus he established upon a few fragments. Entire skeletons were afterward discovered, and two observers, independent of one another, endeavored to found distinct genera upon them. But all later writers have claimed that *Uineatherium* was indubitably founded on the fragments described by Leidy.

Exceptional ability in drawing just inferences from imperfect material signalized Leidy's labors in other directions. He delighted in this kind of work, and numbers of short communications were made by him on abnormalities. Among these may be mentioned the note on the dissection of a male hog, showing arrest of development in the organ of generation (Proc. Phil. Acad. Nat. Sci., 1870, 65); on "polydoctylism" in the horse (Proc. Phil. Acad. Nat. Sci., 1871, 112) and an account of a buffalo fish with congenital narrowing of the mouth (Proc. Phil. Acad. Nat. Sci., 1875, 125).

He was the first authority in the country on questions of disputed identifications. On one occasion a number of alleged fossil bones were sent him for examination, which proved to be inorganic concretions. On another a specimen which a zealous physician thought to be a new genus of parasite from the human intestine proved to be the fragment of imperfectly digested orange pulp. On yet another, a number of bones were sent to him by a physician who obtained them from a woman who claimed to have been pregnant. They were shown to be the bones of an embryo hog.

Dr. Leidy's communications on human anatomy have not been numerous, but they all exhibit the same closeness of observation, and cautious yet far-reaching conclusions.

In 1849, Dr. Leidy redescribed and placed on better foundation the thyreo epiglottideum muscle. In 18— he studied the development of the human temporal bone and described for the first time the attic or upper chamber of the middle ear. The term "attic" has come into general use with aurists. He also entered into a critical revision of the component parts of the petrosa, and corrected several errors into which no less authority than Huxley had fallen. His well-known work on human anatomy appeared in 1860. It was prepared especially for the use of his students at the university. The most noteworthy feature in this work was an attempt to anglicize anatomical nomenclature. In the second edition, which appeared in 1889, the same intent to reform nomenclature is apparent. This department of pedagogy, while of English origin, has had its most earnest exponents in America, and Dr. Leidy's labors in the field will hold always an honorable position. In his teaching, Dr. Leidy held to the existence of a vocal membrane in the larynx, rather than a vocal cord. His demonstration of the temporal muscle was original and clearly demonstrated the existence of two layers arising in an undifferentiated mass at the posterior part of the temporal fossa.

[1] He identified a fragment of the mandible of Bathygrathus as belonging to the maxilla. Owen invited his attention to it. Leidy said of this, "It was an egregious blunder, I cannot understand how I could have made it." A frank confession of a venial error.

From a man of Dr. Leidy's industry we may expect to hear of many plans entertained but subsequently abandoned, of many discoveries actually his own with which his name is not associated. At one time he contemplated writing a work on comparative anatomy, but was deterred from so doing when, upon inquiry of the publishers, he learned how small was the demand for writings of this kind. We cannot but regret that he did not entertain the subscription plan for reimbursement. For no one can doubt the fact that his admirers would have eagerly provided the means for publication had his wishes been more generally known. Respecting his unrecorded discoveries no one can speak with authority. On one subject he has himself spoken, namely, that the discovery of the tactile corpuscle on the nerves of the finger is his own. He occasionally referred to this as an instance of the dangers of procrastination in not placing upon record original observations the moment the facts became clearly defined in the mind of the investigator. He also frequently alluded to his having observed the amæboid movement in the white corpuscles. But he interpreted them to be pathological and hesitated in recording his discovery. This he used to say was one of the greatest mistakes of his life. But no discoveries of this kind were possible at the stage of microscope technique which Leidy commanded; were our knowledge of this property of the white blood corpuscle lost to us it would be exceedingly difficult to re-establish it without the use of the warm stage.

Such is a brief epitome of the labors of Joseph Leidy in the anatomy of vertebrates. It is a theme for a volume. But the man is greater than his works. All who knew Dr. Leidy are witnesses to the impression of strength in reserve he at all times made. It can be said of him as has been said of Haller by Francis Horner: "I never rise from an account of such a man without a sort of thrilling palpitation about me which I know not whether I should call admiration, ambition, or despair."

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.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Work and Energy.

IN many of the standard text-books and treatises on mechanics there is a lack of definiteness in the elementary treatment of the subjects of work and energy that often proves troublesome to the student. To illustrate this, let us place side by side the definitions of work and energy given in the "Syllabus of Elementary Dynamics" prepared by the Association for the Improvement of Geometrical Teaching.

(*a*) When the particle (or point of a body) to which a force is applied moves in the line in which the force acts, the force is said to do work, or to have work done against it, according as the motion is in the sense of the force or in the opposite sense.

(*b*) Energy is a general term for the capability of doing work, which from any cause a mass, or different masses in their relation to one another, may possess.

These definitions are in substantial agreement with those most often given, and are the only explicit statements usually found as to the meaning of work and energy.

A careful reading shows, however, that there is in definition (*b*) an implicit suggestion of something not definitely stated, and concerning which a definite statement is very much needed. According to the definition, energy is possessed by masses (i.e., by bodies); or, in other words, a body may do work. But what is meant by a body doing work? In most text-books the student will search in vain for a definite answer to this question.

Another question is suggested by the definition of work above quoted. It is clearly stated when work is done by a force and when work is done against a force. But in the latter case, what is it that does the work?

These two questions are sure to present themselves to the thoughtful student. If the definition of work were so stated as to furnish explicit answers to them, the acquirement of correct notions would be much facilitated.

A source of confusion slightly different from that above mentioned is found in certain books. Work is defined as if always done by forces; while energy is defined simply as capacity for doing work. The inference might naturally be drawn that energy is possessed by forces. But the student who draws this logical conclusion will be perplexed by finding that, in what follows, energy is always referred to as belonging to bodies instead of forces.

As an improved statement of the fundamental definitions of work and energy, the following may be suggested:

1. A force does work upon the body to which it is applied when the point of application moves (or has a component of motion) in the direction toward which the force acts.

2. A body does work against a force applied to it when the point of application moves (or has a component of motion) in the direction opposite to that toward which the force acts.

3. A body possesses energy when its condition is such that it can do work against applied forces.

Definitions (1) and (3) are not substantially different from definitions commonly given. Definition (2) is usually not given explicitly, though always implied in the development of the theory of energy.

It is quite possible that these definitions may admit of improvement. They must, of course, be accompanied by quantitative statements as to how work and energy are to be computed. But it is believed that the clear development of the subject is much facilitated if explicit definitions similar to these are given at the outset.

No attempt is here made to criticise all the various methods of treating the subject of work. Other forms of definition than the one above considered are found in various books. In most cases, however, they lead to the same difficulty above mentioned.

A treatment practically identical with that here suggested is adopted in McGregor's "Kinematics and Dynamics" — a book possessing many other admirable features — and possibly in other works. It certainly is not adopted by some of the best known English writers. L. M. HOSKINS.

Madison, Wis., Nov. 9.

AMONG THE PUBLISHERS.

EVER since the announcement made last winter that the author of "Robert Elsmere" had a new novel under way, expectation has been eager to know when it would appear. Mrs. Ward, like George Eliot, has once more taught us that fiction, far from being merely a superficial representation of passing situations and emotions, may grapple with the greatest problems and teach men noble truths. It is with pleasure, therefore, that we publish the fact that Mrs. Ward's new book is to appear very soon from the press of Messrs. Macmillan & Co., New York, and that it is to be called "The History of David Grieve." It is understood that the book will trace the career of a disciple of the Elsmerian doctrines in his work among the poor of London.

— There lives an Indian people on the Carribbean coasts of Nicaragua and parts of Honduras, which is largely mixed with African and Indian elements, foreign to them, on the littoral tracts, but farther inside is of purer race. This people is known to the whites as Moskitos, or as they want to be called, *Misskitos*; their language was but imperfectly studied, probably because the tribes inspired their visitors with contempt on account of their subserviency to English interests. Only the missionaries of the Herrenhut denomination spent time enough for mastering entirely the intricacies of this tropical language, and from their writings, as well as from those of Rev. M. Henderson, of Rev. W. Grunewald, and of three Prussian delegates sent to Nicaragua before 1845. Mr. Lucien Adam has made a through investigation of this tongue. His "Langue Moskito" has just been published by J. Maisonneuve, 25 Quai Voltaire, Paris, and forms the fourteenth volume of his "Bibliothèque linguistique Américaine" (134 pp., 8°). The texts include a number of stories from the New and Old Testament and some hymns, the ten commandments and two love songs, all with a French translation. The vocabulary fills thirty pages and the grammatic sketch contains the full paradigms of several verbs, which inflect by person-suffixes and possess a negative form. The phonetic side of the idiom may be characterized as rather vocalic than consonantic and the vowels *a*, *i*, *u*, largely exceed in frequency the other vowels.

— A novelty in calendars is the "Slide-Rule Perpetual Calendar," recently issued by the Jerome-Thomas Company of this city. As its name indicates, it is an application of the well-known slide-rule principle to a perpetual calendar, by means of a table of year-letters extending from the first year of the Christian era to the year 2800 (with means of infinite extension).

— The pictures of outdoor life in Canada presented in "Lady Dufferin's Journal" will interest many readers. Lady Dufferin gives a description of the various social and civic functions in which she took part with the Governor-General, and she also describes her salmon-fishing and camping trips. "Lady Dufferin's Journal" is published by D. Appleton & Co.

— Houghton, Mifflin, & Co. announce "Colonial Furniture of New England," a study of the domestic furniture in use in the seventeenth and eighteenth centuries, by Irving Whitall Lyon, M.D., member of the Connecticut Historical Society, illustrated with about one hundred large heliotypes; also the twelfth volume of the *Gentleman's Magazine Library*, comprising the articles on "English Topography," edited by G. L. Gomme.

— Another volume of Mr. Lowell's essays is said to be in the hands of his executor, Professor Norton, and will shortly be published. It will include Lowell's papers on Milton, Gray, and Landor; his sketch of Keats prefacing poems of Keats in the "British Poets"; his paper on Izaak Walton, printed as an introduction to the recent edition of "The Complete Angler," and an address before the Modern Language Association.

— Messrs. Longmans, Green & Co. will publish next month Mr. W. J. Henderson's new book, "Preludes and Studies; Musical Themes of the Day." The volume will contain a discussion of that fruitful theme, Wagner's "Ring des Nibelungen," together with other interesting Wagnerian essays. Perhaps the most valuable feature of the book for students and lovers of music in general will be the essay on "The Evolution of Piano Music," which includes a mass of facts not before accessible from any one source, and most of which are not to be found in any other work in English. The study of Schumann's symphonic writing will appeal to all readers who look below the surface of music.

— An account of "The Rise of the Pottery Industry," by Edwin A. Barber, is to appear in the December *Popular Science Monthly*. It will be illustrated with figures of early American ware, the apparatus used in making it, etc. This is the tenth article in the Monthly's illustrated series on American industries. Volcanoes in Connecticut are what very few persons would expect to find, but Prof. W. M. Davis has found a place near Meriden where they have been, and will describe his discoveries in an illustrated article. The fourth and last of Prof. Frederick Starr's papers on "Dress and Adornment" will also appear. It deals with "Religious Dress," including the dress of religious officers, of worshippers, of victims, of mourners, amulets and charms, and the religious meaning of mutilations. It will be illustrated. An invention that bids fair to work a revolution in printing, namely, type-casting machines, will be described by P. D. Ross. A cut of each of the two forms will be given. These machines are used by several of the largest newspapers in the United States, and have been ordered for a number of others. The principles involved in "The Training of Dogs" will be given by Dr. Wesley Mills. The article will contain pictures of a number of champion hunting-dogs.

— The History Company, San Francisco, Cal., have just issued another volume of H. H. Bancroft's series of "Chronicles of the Builders of the Commonwealth." Instead of following the publication of Vol. I. of this work with Vols. II., III., and IV., the publishers skip for the time being to Vol. V., the intervening volumes being nearly ready and to follow at short intervals. In the framework of Vol. V., the subject of which is "Routes and Transportation," there is much original matter. The material is drawn from innumerable original sources never before put into print. It covers the entire groundwork of inland and oceanic navigation, stage lines, telegraphic lines, and railway lines, the evolution of the express business, and everything connected with the subject in the fullest detail and in the most interesting style.

— One of the largest book deals ever consummated in America, it is reported, was closed Oct. 27 by cablegram, the University of Chicago being the purchaser and S. Simon of Berlin, the seller. The library contains 280,000 volumes and 120,000 dissertations in all languages. Among them there are 200 manuscripts from the eighth to the nineteenth century, 1,600 volumes of paleography, 15,000 journals, academies, and periodicals, 65,000 volumes of Greek and Roman archæology, 65,000 Greek and Roman classics, 2,400 volumes Greek and Latin authors of modern times, 2,000 Greek and Roman philology and grammar, 2,000 volumes general linguistics, 3,000 volumes modern linguistics, 2,500 volumes history, 1,000 illustrated works of art, 5,000 volumes physics, astronomy, and mathematics, and 5,000 volumes natural history.

— We have received from C. W. Bardeen of Syracuse a little pamphlet entitled "Thoughts from Earnest Women," arranged by the Women's Literary Club of Dunkirk. It consists of brief extracts, mostly in prose, from a large number of women writers of various times and countries, and is a collection of considerable merit. Most of the extracts relate to the conduct of life, some being moral, others prudential, and they indicate for the most part good sense both in the authors and in the compilers. The compilers are in favor of widening woman's sphere of work and of influence, and do not believe that she ought to confine herself exclusively to her family; and several of the authors quoted are advocates of woman suffrage. The interest of the collection, however, is by no means confined to women readers, but most of the extracts are as interesting and instructive to men as to women. The pamphlet is well worth the fifteen cents that it costs. Mr. Bardeen also sends us a work on "Elementary English," by John D. Wilson, prepared with reference to the Regents' examinations in the State of New York; but we cannot say that the work is well fitted for its purpose. The Regents issued in April last a bulletin in which they sketched a course of study in the elements of English, and this book has evidently been hastily gotten up to meet the Regents' requirements. The definitions are altogether too brief and too abstract, with very few illustrative examples; and the rules of punctuation are insufficient, and not illustrated by any examples at all. Moreover, there are some grammatical blunders in the book, as, for instance, in the first paragraph, where we read that "the word or words which makes the assertion is the predicate." When two subjects are connected by *or*, the verb ought to agree with the one that stands the nearest, and therefore the above sentence ought to have read thus: the word or words which *make* the assertion *are* the predicate. The book may be of some use to teachers as a synopsis of its subject, but it is of no value to students.

— Whittaker & Co., London, has just issued "Light" in the "Whittaker Library of Popular Science." This book is by Sir Henry Trueman Wood, Secretary of the London Society of Arts, who makes no pretence of being a specialist in the department of physics of which he writes, but he claims a thorough familiarity with the difficulties which beset the path of those humble students of science who can devote their leisure only, not their working life, to their favorite pursuit. This perhaps indicates, as well as anything could, the mode of treatment of the subject; and, as to the scope of the book, it may be said that all the usual phenomena of light are described, and something of the theory given, though we do not find any reference to the recent investigations of Hertz and others showing experimentally the relation between light phenomena and those of electricity. Macmillan & Co. are the New York publishers.

—The Rev. Alfred J. Church, the well-known author of "Stories from Homer," etc., has written a novel of the time of Nero, which Macmillan & Co. will publish under the title of "The Burning of Rome." The book, which contains a number of illustrations, is just ready.

—"Principles and Practice of Plumbing," by S. Stevens Hellyer has just been issued by D. Van Nostrand Co., New York. It would seem that it might be difficult to find a person with sufficient knowledge of plumbing and having the habit of writing sufficiently developed who could produce a book on the subject. These two qualities are united in Mr. Hellyer, who is known for his earlier books, "The Plumber and Sanitary Houses," and "Lectures on the Science and Art of Sanitary Plumbing," The present volume is one of the series of "Technological Handbooks" edited by Sir H. Trueman Wood, Secretary of the London Society of Arts, to which Prof. William Crookes, for instance, contributed the initial number, on "Dyeing and Tissue-printing." The opening chapters are devoted to lead and its many uses in building operations, but the rest of the book contains much on what is known as sanitary engineering, at least in so far as this may be limited to the house.

—Houghton, Mifflin & Co. have published a small volume entitled "Land of the Lingering Snow," by Frank Bolles, being an account of outdoor walks in New England in spring time. It is, therefore, somewhat in the style of Thoreau's works, though Mr. Bolles is hardly equal to his prototype. His work is almost entirely descriptive, with hardly any of those moral reflections such as often light up the pages of Thoreau. Moreover, it is too full of petty detail, as the following specimen passage will show: "Leaving the railway, I wound my way back towards Stony Brook, passing through groves of small oaks, meadows full of treacherous pools covered with brittle ice, belts of whispering white-pines, apple orchards and wood-roads leading up hill and down, ending nowhere. Four miles of this wandering brought me to Kendal Green station in Weston, with a record of twenty crows, eighteen chickadees, sixteen tree-sparrows and three blue jays" (p. 40–41). For lovers of nature, however, the book will have an interest, and it is written in a simple and refined style.

—The November number of the *Annals of the American Academy of Political and Social Science* is interesting on account of the number of articles it contains which discuss new ideas about American politics. Gamaliel Bradford is the author of the first article, which is entitled "Congress and the Cabinet," and which advocates permitting cabinet officers to appear in Congress to give advice and answer questions. "The Place of Party in the Politcal System," by Anson D. Morse of Amherst College, is a defense of the party system. E. P. Oberholtzer in his "Law making by Popular Vote," shows that there has been used at various times in American history a form of the Swiss Referendum. The other two main articles are "Recent Tendencies in the Reform of Land Tenure," by E. P. Cheyney, of the University of Pennsylvania, and "Some Neglected Points in the Theory of Socialism," by T. B. Veblen. The department of the *Annals* devoted to personal notes contains brief biographies of the following men, who have been appointed to positions in the schools of political science or political economy in the various colleges: J. R. Commons of Oberlin, W. M. Daniels of Wesleyan, Marietta Kies of Mills College, E. A. Ross of the University of Indiana, F. H. Hodder of Kansas State University, H. B. Gardner of Brown, S. B. Weeks of Trinity, N. C., C. G. Tiedeman of the College of the City of New York, C. F. A. Currier of the Massachusetts Institute of Technology, W. F. Willcox of Cornell, F. W. Moore, S. Sherwood, A. B. Woodford and L. K. Stein of the University of Pennsylvania, Max von Heckel of Wurzburg, Cort van den Linden of Amsterdam, and Achille Loria of Padua. There has been a change in the editorial force of the *Annals*. Professor F. H. Giddings, formerly one of the associate editors, has resigned on account of his many outside duties, and Dr. J. H. Robinson of the University of Pennsylvania has been appointed in his place. Dr. Robinson is lecturer on European history in the Wharton School of Finance and Economy, and is the author of a monograph on the "Original Features of the United States Constitution," and a work on the "German Bundesrath."

SCIENCE

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SCIENCE

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THE SCIENCE AND ART OF GOVERNMENT.[1]

GOVERNMENT should be looked upon as the business agency of the nation, and the science and art of government are the science and art of conducting this business agency. The various branches of administration have arisen through pressure from without. Everything that the people have demanded to be done with sufficient unanimity and persistence has been eventually undertaken by the government. One bureau after another has been created by law, placed in charge of proper officers, and conducted to the best of the latter's ability. Most bureaus have grown and expanded in their scope and usefulness. Many have been several times reorganized and the service perfected.

Although the various systems of administrative operation have been largely empirical, devised by men who had little preliminary preparation for the work, improved through the growth and demands of the service, and brought to perfection by thoughtful study of the needs of the public in each individual case, still the whole rests on a rational basis and constitutes a great system of government. The general laws and principles underlying this system constitute the science of government. The carrying out of these laws and principles is the art of government, and although, as in the case of almost all the practical arts, it was empirically developed, there is no reason to doubt that it will be as greatly improved and perfected by its reduction to a science and its enlightened prosecution as such as all the other great industrial arts have been since science has been applied to them.

Among the most promising sources of advantage in the scientific method is the comparative study of government operations. While from a very broad point of view all government is the same, when viewed at all in detail the greatest individual differences are found. Much of this diversity grows out of the natural differences in the conditions of nations, but fully as much is due to the differences in the methods adopted to accomplish the same purpose. Amid all these varying methods there must be great differences in their efficiency. Some are coarse and clumsy, while others are precise and refined. There are all the grades that exist in the manifold mechanical devices of the other arts, those which are best being always those which have most thoroughly utilized natural forces, including the social forces.

The scientific study of government would make the comparative study of methods a leading feature, with a view to the recommendation of those which under all circumstances are the very best. This is only one out of any required number of illustrations that might be given of the superiority of the scientific method in government.

In the science of political economy the subject of government operations is destined to occupy an increasingly prominent place. It is safe to say that no chair of political economy in any institution of learning has ever taught or attempted to teach the practical workings of public administration — the way in which the business of a nation is conducted. It is impossible to teach this branch of political economy without the means of a direct examination of the different systems of government business as they are conducted by their respective bureaus. Each great system, such as those of finance, land, patents, etc., would require a course of lectures, with repeated visits to the departments, inspection of records, books, papers, merchandise, etc. This would require a legal right to prosecute the study in this only practicable way. Nothing short of a national institution, created and authorized by law to teach the science and art of government, could successfully carry out this scheme of education. As a safeguard to our institutions, not less than as means of national progress and enlightenment, no other educational scheme is equal to it in importance.

[1] Read before Section I of the American Association for the Advancement of Science, at Washington, D.C., by Lester F. Ward, Aug. 20, 1891.

A NATIONAL UNIVERSITY, ITS CHARACTER AND PURPOSE.[1]

THE National University recommended by Washington, Jefferson, Madison, and many later presidents and statesmen is almost certain to be realized in the near future. It is the object of this paper to offer some hints as to what ought to be its character and purpose.

In the first place, it should be distinctly national, the creature of the American people and devoted to their use and needs. To this end it should be located at the seat of government and should be exclusively the product of the federal government. It should also be in the fullest sense representative, as is the government itself. Its scholarships should be held entirely by Americans, and should be distributed with local uniformity throughout the entire domain of the United States. Recognizing the intellectual homogeneity of the whole American people, it should have representatives from every section of the country. This could probably best be secured by allotting a given number of scholarships to each congressional district on the basis of representation as determined by the census enumeration. Candidates should be admitted by competitive examination held by the faculty or an examining board appointed by the faculty, to be absolutely free from all political influence. As the intellectual homogeneity of the American people relates to capacity and not to attainment, in order to secure such universal representation, the university should be accompanied by a preparatory department, and those who pass the examination for the university should have no advantage over those who pass for the preparatory department, except that, if a sufficient number pass for the former, examinations for the latter need not be held. Candidates who enter the preparatory department should be given precedence over those from the same district at the end of that course for admission to the university.

The faculty should be chosen by a commission consisting of the most eminent scholars and scientific men in the country, who are entirely above personal and political bias, such, for example, as the National Academy, the Board of Regents

[1] Read before Section I of the American Association for the Advancement of Science at Washington, D.C., by Lester F. Ward, Aug. 20, 1891.

of the Smithsonian Institution, and other high authorities in the leading departments of learning.

While the institution should be a university in the fullest and widest sense, it should differ from all other universities in one important respect. All universities have their strong chairs, and many rest their reputation on some one leading feature. The leading feature and true reason for being of the national university should be its course of instruction in the science and art of government. This course should differ radically from the usual courses in political economy and political science. These should not be neglected, but in addition to them and of higher range should stand as the basis of university instruction a thorough and exhaustive course in the practical workings of government itself. Viewing government as the great agency for the transaction of the people's business, every department of government business should be fully taught both in its principles and its practice, so that the graduate from the national university should come forth in full possession not only of all that constitutes true statesmanship, but also of the practical details of each of the many great business operations which the government undertakes and carries on.

The administrative offices of the government should be filled as soon as possible from graduates of the university, so that at length the civil service force of the United States should consist exclusively of persons who have had a thorough training in the theory and practice of government.

PRINCIPLES AND METHODS OF GEOLOGIC CORRELATION BY MEANS OF FOSSIL PLANTS.[1]

The value of paleontology to geology depends primarily upon the principles by which the paleontologist is guided in the application of his data, and accordingly upon the methods he adopts in bringing such data to bear upon the questions which geology presents for solution. This is especially true of paleobotany, and the chief reason why that branch of paleontology has thus far been so little help to geology is that unsound principles or improper methods have been employed in reasoning from paleobotanical data.

Among the leading principles by which the paleobotanist should be guided may be mentioned the following: —

1. It should not be expected that widely separated deposits having similar floras are necessarily identical in age, since the present well-known laws of geographical distribution are likely to have been operative to a greater or less degree in past geologic ages, and the flora of the entire globe has probably never been homogeneous throughout. Different deposits may therefore be homotactically correlated without being contemporaneous, while, on the other hand, those having very different floras may have really been contemporaneous.

2. The great types of vegetation are characteristic of the great epochs in geology. This principle is applicable in comparing deposits of widely different ages where the stratigraphy is indecisive. For example, in rocks that are wholly unknown, even a small fragment of a carboniferous plant proves conclusively that they must be paleozoic, or a single dicotyledonous leaf that they must be as late as the cretaceous.

3. For deposits not thus widely different in age, as, for example, within the same geological series or system, ample material is necessary to fix their position by means of fossil plants. As this is the most common case, it is the neglect of this principle that has led to the greater number of errors and done most to bring paleobotany into disrepute. The geologists have expected too much of paleobotanists, and the latter have done violence to the truth by attempting to satisfy the extravagant demands of the former. On the other hand, where the material is ample fossil plants are as reliable as any other class of paleontologic data.

4. The correct systematic determination of fossil plants concerns biology and does not concern geology. Much of the contempt exhibited in some quarters for paleobotany has arisen from the impression that there is great uncertainty with regard to the true nature of vegetable remains. This uncertainty is greatly exaggerated even by botanists, who are apt to imagine that nothing can be known of a plant without having all its organs and parts before them. But the geologist need not be affected in the least by these discussions, since all that is required from his point of view is that the fossil be definite, constant, and easily recognizable, as is usually the case with plants. Such as possess these qualities and are also characteristic of a given deposit have their full diagnostic value independently of the question whether their true systematic position has been determined or not.

As regards methods in geologic correlation by means of fossil plants, it is chiefly important that the tables of distribution be complete and comprehensive; that is, that they embrace all the forms found elsewhere, and that all the other localities and formations in which they occur be indicated. It is also important when comparing floras as ancient as the Mesozoic, that those species be enumerated which are obviously related to those of the deposit to be determined. In the discussion of such tables of distribution due regard should be had for the fact that the types of earlier floras often pass up into later ones, and when the latter are much more abundant than the former their occurrence argues much more strongly for the earlier than for the latter date — for the Devonian than the Carboniferous, and for the Cretaceous than for the Tertiary. Many serious errors have been committed by ignoring this principle.

[1] Read, by Lester F. Ward, before Section E of the American Association for the Advancement of Science, at Washington, D.C., Aug. 21, 1891; a translation into French was also read in part before the International Congress of Geologists at the same place, Aug. 29, 1891.

NOTES AND NEWS.

The public meetings of the Nineteenth Century Club, New York, during the coming season, will be held on the following Tuesday evenings, viz., Nov. 17, Dec. 15, Jan. 12, Feb. 16, Mar. 15, and Apr. 12. There will be six conversational meetings of the members of the club during the coming season, to be held upon the first Friday evening in each month.

— The following papers were entered to be read at the November meeting of the National Academy of Sciences: Some Aspects of Australian Vegetation, and The Nomenclature of Vegetable Histology, by G. L. Goodale; On Certain New Methods and Results in Optics, by Charles S. Hastings; An Exhibition of the New Pendulum Apparatus of the United States and Geodetic Survey, with Some Results of its Use, and On the Use of a Free Pendulum as a Time Standard, by T. C. Mendenhall; On Degenerate Types of Scapula and Pelvic Arches in the Lacertilia, by E. D. Cope; The Proteids or Albuminoids of the Oak-Kernel (second paper), by Thomas B. Osborne, introduced by S. W. Johnson; Astronomical Methods of Determining the Curvature of Space, by C. S. Pierce; On Geographical Variation among North American Birds, considered in relation to the peculiar Intergradation of *Coloptes Auratus* and *C. Cafer*, by J. A. Allen; On the Variation of Latitude, by S. C. Chandler; The Tertiary Rhynchitidæ of the United States, by Samuel H. Scudder; On a Color System, by O. N. Rood; Preliminary Notice of the Reduction of Rutherford's Photographs, by J. K. Rees, introduced by E. C. Pickering; On the Application of

Spectrum Analysis to the Analysis of the Rare Earths, and a New Method for the Preparation of Pure Yttrium, by H. A. Rowland; A Nomenclator of the Family of Fishes, by Theodore Gill; Measurement of Jupiter's Satellites by Interference, by A. A. Michelson; The Follicle Cells of Salpa, by W. K. Brooks.

— The council of the Appalachian Mountain Club has been informed by Mr. Henry Brooks of West Medford that if $2,000 can be provided for the care of the property, Virginia Wood, situated in Middlesex Fells, on the north side of the Ravine Road, will be given into the keeping of the Trustees of Public Reservations. The council recommends this project to the favorable consideration of the members of the Appalachian Mountain Club, reminding them that this work is in the line of the club's work and that the club called the meeting which resulted in the incorporation of the Trustees of Public Reservations. Offers of large or small subscriptions may be sent to Mr. Henry Brooks, West Medford, or to the recording secretary of the club. The club's Exhibition of Botanical Specimens will be held the second week in December.

— At what elevation is the air of London purest? According to Mr. W. J. Prim, who gave evidence before the Select Committee on House of Commons Ventilation, says the *Pall Mall Gazette*, at about thirty or forty feet from the ground. Lower than that you get the dust, higher than that you get the smoke from the chimneys. Mr. Prim made certain experiments with frames of wood covered with blanketing material put at different elevations — one on the top of the clock-tower at Westminster, another on the highest point of the roof, and others at various heights down to the court-yard. After five-hours' exposure there were found to be more smuts at high elevations than at the low, but on the level of the courtyard there were considerable quantities of dust. On the whole, Mr. Prim came to the conclusion that the purest level was between thirty and forty feet, and that nothing was gained by going higher, unless you went very high indeed — say, some 400 or 500 feet. All this is rather fatal to the common notion that the highest stories of the tallest blocks of flats are especially desirable for their salubrious air.

— "If any evidence of the fury of the equinoctial storms that have lately raged in the Atlantic were needed, in addition to the lengthening list of 'Disasters at Sea' which has appeared daily during the past three weeks," says the *London Spectator*, Oct. 31, "we might find it in the number of ocean-birds which have been driven from distant seas, and even from other continents, or the New World itself, and have drifted to the rain-soaked fields of England. No doubt all shore-birds are liable to be driven inland during a gale; but these are rarely, if ever, lost in a storm. Every sea-gull and cormorant, puffin, or razor-bill, has its own home, the particular shelf or ledge of cliff on which it sleeps every night, and from which it launches itself over the sea when the first streak of dawn appears upon the waters. But these are only 'long-shore' birds that can lie snug in harbor, like their rivals the fishermen, and suffer, like them, mainly from the interruption of their fishing. When the true ocean birds, like the petrels, are found scattered inland, dead or dying, as has been the case during the past month, we may safely infer that the weather from side to side of the Atlantic has borne hardly, not only on the ships, but on the friendly birds that love to follow them. Numbers of these, of at least two different kinds, one of which, as a rule, makes the Azores the eastern limit of its ocean range, have appeared on our coasts or inland during the gales. Wilson's petrel has been seen in Ireland, in County Down, and a second is said to have been shot on Lough Erne. The fork-tailed petrel, another ocean species, has lately appeared here in far greater numbers. These birds have been seen in Donegal, and in Argyllshire, in Westmoreland, and in the Cleveland district in Yorkshire. As the last appeared after a strong north-western gale, it seems that it must not only have come in from the Atlantic, but have flown over England before falling exhausted to the ground. They have also been seen in Tipperary, at Limerick, Dumfries, and Northampton. From an account given of these petrels in Argyllshire, it is clear that they retained after their long journey all that misplaced confidence in man which marks their behavior when accompanying ships in mid-ocean. After five had been shot by the owner of a yacht in Loch Melfort, they settled on the vessel, and one allowed itself to be caught under the sou'wester hat of a sailor."

— During the nine years and six months preceding December, 1884, there had occurred in Japan, according to statements published in the *Illustrated American* five hundred and fifty-three earthquakes, averaging one earthquake for every six days and six hours. Professor Milne was able to make the average even greater than this. He could trace an average of an earthquake per day in Nagasaki, in the extreme south of the Japanese Archipelago. Probably the official statistics were compiled from the returns of officials from all over the country, in which case only those shocks which caused loss of life or damage to property would be included. If this hypothesis be correct, we should have an average of more than one earthquake per week, which was so violent that it caused injuries to life or property sufficiently serious to attract the attention of the local authorities, and, in their judgment, to require a report to the central government. Earthquakes being so common, people scarcely notice them unless they be extraordinarily severe ones. For instance, Miss Bird, in her "Unbeaten Tracks," thus summarily dismisses two: "While we were crossing the court there were two shocks of earthquake; all the golden wind-bells which fringe the roofs rang softly, and a number of priests ran into the temple and beat various kinds of drums for the space of half an hour." As every one knows, Japan is the very hearth of earthquakes; in 1854 more than sixty thousand people lost their lives in consequence of one of these great terrestrial catastrophes, and it has been calculated that from ten to twelve earthquakes, each lasting several seconds, occur every year, besides numerous others of too light a nature to be worthy of remark.

— The subject of the use of the flesh of animals killed by poison has been studied by Schmidt-Mulheim with a view to determine whether, if eaten by men, such flesh would be injurious. As reported in the *Revista Internazionale d'Igiene* of Naples, for June, 1891, it may be used without any danger whatever. Many savage races constantly use the flesh of the animals that have been killed with poisoned weapons and have never been injured by that means. Harms has proved (*Univ. Med. Mag.*) that the flesh of animals that have been poisoned with nux vomica and with tartarized antimony is not at all hurtful; Feser has demonstrated the same fact in regard to strychnine and eserine; Spallanzani, Zappi, and Sonnenschein have done the same for arsenic. Froehner and Knudson have made some experiments for this purpose with strychnine and with eserine. They fed dogs with large quantities of mutton poisoned with strychnine and eserine, and they found that no injury whatever was done to the animals. Besides, they themselves ate some of the poisoned meat and drank soup made from it, and found that the flavor was good and had no injurious effects whatever on the system. In regard to the alleged injurious effects caused by the meat of animals poisoned with hellebore, and which had eaten belladonna leaves, the authors have shown that the accounts published in this regard have not been proved and require further tests.

— The experiments in the use of commercial fertilizers on wheat, made at the Ohio Experiment Station, have been criticized on the ground that it is idle to expect any profitable return from fertilizers applied to a soil naturally so rich as that of the farm occupied by the station. This criticism was anticipated when these experiments were instituted, and accordingly a test, duplicating the most important features of the station test, was begun at the same time on a tract of land in Columbiana County, placed at the disposal of the station by its owner for this purpose. The soil on which this test is located has been derived from the decomposition of underlying slate, and is a light colored clay or clay loam, of moderate productiveness, the crops of wheat grown upon it under ordinary farm management having averaged from fifteen to twenty bushels to the acre. It is naturally underdrained by the cleavage of the underlying rocks, but the contour is not so uniform as that of the section devoted to similar tests at the station, and hence the results are less regular. In Bulletin No. 3 of the Ohio Experiment Station for 1891 the results of the experiments for this year on the station farm are given, the general outcome being that in most cases the use of manure or fertilizers caused an absolute decrease in the product of grain, an immense growth of straw having been produced at the expense of the grain. In summing up the results of this experiment, it was said: "It is expected that this year's results of the duplicate experiment in Columbiana County will show better returns from the use of fertilizers than those of the station test, but it has not been possible to thresh out that experiment in season to publish its results in this bulletin." The wheat was threshed on Oct. 17, and the results show no increase to justify the expenditure on fertilizers.

— At the recent Congress of Tuberculosis, M. Poirier (*British Medical Journal*) read a paper on the surgical treatment of pulmonary cavities. He said the first case on record was accidental. In a duel fought in 1679, the sword of one of the combatants passed through his antagonist's lung and opened a pulmonary cavity. The surgeon utilized the wound for the direct treatment of the cavity, and the patient recovered. In conjunction with M. Jonnesco, M. Poirier has collected all the available statistics, of which the following is a summary. Of twenty-nine cases of incision of tuberculous cavities with resection of ribs, improvement took place in fifteen, cure resulted in four (these cases must, according to M. Poirier, be taken "with every possible reserve"), in nine the result was negative, in one it was unknown. In nineteen of the cases the disease was situated near the apex. M. Poirier, still with the co-operation of M. Jonnesco, has endeavored to simplify the method of operation so as to minimize the amount of traumatism. The following, according to them, is the best way of reaching the upper part of the lung. An incision is made with the thermo-cautery four centimetres below the sterno-costal notch from the middle line of the sternum outwards for nine centimetres in a direction parallel to the first intercostal space; in this way the pectoralis major, which is usually much thinned, is reached, and by enlarging one of the spaces between the fasciculi the plane of the intercostal muscles is reached. This is divided and the pleura exposed. If there are no adhesions it is better to establish them before proceeding further; but if there is a cavity adhesions are always present. It is easy to "strike" the cavity through these adhesions, though a certain thickness of pulmonary tissue has often to be traversed for the purpose. As cavities are generally situated quite in the upper part of the lung, the first intercostal space is at a distinctly lower level than the cavity; the point of the instrument must therefore be carried from below upwards and from before backwards. When the cavity lies towards the back, the spinous process of the seventh cervical vertebra should be sought for; an incision is made outwards from this point towards the scapula; the trapezius and rhomboideus are divided, and the first intercostal space, which is much less wide than it is in front, is reached. Resection of rib may be necessary, but M. Poirier does not advise this. From experiments made on twenty dead bodies, he holds that in front resection of ribs is never called for.

— The Italian Society of the Red Cross has recently been conducting some elaborate experiments to test the working of floating hospitals. In countries where water communication is complete, well equipped hospitals on barges might be of very great service, especially in time of war. The presidents of the Red Cross and Italian Rowing Club, with Captain Olivari of the Italian navy, set themselves to the task, first by forming a floating hospital out of the barges employed on the main water-ways for the transport of combustibles; then, having got their flotilla in working order, they launched it on the Lago Maggiore (*Lancet*, Sept. 19). Passing thence by canal to Milan, it anchored at the Porta Ticinese, and was there visited by a large number of citizens. It is composed of three barges, two of them fitted up for the accommodation of the wounded, and the third for a pharmacy, a kitchen, and the necessary stores. Of the two hospital barges, one is set apart for wounded officers, the other for wounded soldiers of the line — the two containing twenty-four beds each at present, but capable of including comfortably thirty-six each. These beds are partly on the fracture-board system, partly supported on network of metal, and are all furnished with mattresses and pillows stuffed with *zostera marina* (dried seaweed), which has the twofold advantage of being non-combustible and antiseptic. Every night-requisite is conveniently at hand, and ventilation is secured by an ingenious canvas awning which gives passage to a continuous circulation of air while protecting the patient from draughts. The flotilla is lighted with oil lamps, and the barge reserved for the wounded officers has accommodation at the prow for the *personnel*, superior and inferior. The store barge consists of a dispensary, an *armamentarium chirurgicum*, a provision magazine, with ice-machines, and a spacious kitchen, capable of supplying 250 mouths. There is also a complete system for storing and keeping cool and pure a perennial water-supply — a system due to the Cavaliere Borroni, secretary to the Milanese Committee of the Red Cross. The flotilla is composed of nine barges in all: the three above described having been sent down to Milan for exhibition from the Lago Maggiore, while the remaining six are in dock at Arona, on the southern extremity of the lake. These barges are moved on the lakes by tugs, on the rivers by the current, on the canals by towing horses. From Milan the flotilla proceeded by canal to Pavia, and from Pavia down stream to Piacenza, at every station commanding the highest admiration. The experiment — the first of its kind ever made — is a worthy complement to the mountain ambulance of the Italian Red Cross Association.

— A large number of migratory birds passed over Dublin during the night of May 4 last, on the way to their northern breeding-haunts. An account of the matter is given by Mr. Allan Ellison in a recent number of the *Zoologist*. "While sitting in our rooms in Trinity College, about 11 P.M.," he says, "we were attracted by the loud call-notes of birds passing overhead. The night was calm and cloudy, not very dark. We listened at the open window until about 1 A.M., when they seemed to be still passing over in undiminished numbers. They were mostly golden plovers and dunlins, easily recognized by their notes, but we frequently heard the cry of the whimbrel, or the shrill call of the common sandpiper. It was most curious to hear these notes, at first far away towards the south-west, gradually becoming louder as the flocks drew nearer and passed overhead, and then rapidly passing away to the northward. Sometimes the whole air seemed full of their clear whistling notes; in one direction the loud, short pipe of the golden plover, in another the shrill wheezing cry of the dunlin, reminding one of the sound made by a whistle with a pea in it. Sometimes a bird or two would fly quite close over the house-tops, uttering its loud whistle close to the open window, but they seemed for the most part to fly at a great height."

— The Biological Club of the Ohio State University and Ohio Agricultural Experiment Station met Nov. 3, and elected the following officers to take their places at the next meeting: president, Professor W. A. Kellerman; vice-president, Professor F. M. Webster; secretary, C. M. Werner. The club is in a more flourishing condition and doing better work this fall than ever before. It is composed of over a score of professors and advanced students, mostly specialists Some idea of a part of the work and workers may be gained from the following, which is the programme for this term: Sept. 23, "Notes on Personal Work and Reports on Recent Scientific Literature;" Oct. 7, Professor Kellicott, "On Certain Crustaceous Parasites of Some of Our Fresh-Water Fish;" Oct. 20, Professor Kellerman, "Germination Tests in Connection with the Use of Fungicides on Grain;" Nov. 3, Election of Officers; Annual Address by the President, Professor W. R. Lazenby; Nov. 17, Dr. Orton, "Geological History of the Black Shales of Columbus;" Dec. 1, Professor Webster, "The Relation between the Increase of certain Insects and the Overflow of Rivers;" Dec. 15, Professor Selby, "Ohio Oaks." During the remainder of the year the following subjects will be discussed: "Report of a Biological Survey of Ohio River Waters," by Dr. Bleile; "Methods of Propagation or Multiplication in the Lower Forms of Animal Life," by Professor Kellicott; "Methods of Propagation or Multiplication in the Lower Forms of Vegetable Life," by Professor Kellerman; "Protective Mimicry in Insects," by Professor Webster; "Palæozoic Mollusca, with Stages of Molluscan Development," by H. A. Surface; "The Botanical Order of Violaceæ," by E. E. Bogue;

"Some Observations of Animal Life in my Aquarium," by J. H. McGregor. Other professors and advanced students will deliver addresses or read papers, the subjects of which have not yet been given. Besides the regular paper at each meeting, there are notes on personal work, recent discoveries, investigations, etc., by the various members, and reports on current scientific literature. At the meeting Nov. 3, the president, Professor Lazenby, recommended that immediate action be taken toward the formation of an Ohio State Academy of Science. The suggestion was acted upon at once, and a committee, consisting of Professor W. R. Lezenby, D. S. Kellicott, and W. A. Kellerman, was appointed to make further arrangements in this direction, and to correspond with scientific workers throughout the State with a view of securing their co-operation. Correspondence from all persons interested is earnestly solicited.

— It is reported that the decline in the supply of Bahia piassava still continues, and that the bark is becoming exceedingly scarce, owing to the reckless manner in which the trees are stripped. Bahia piassava, as is well known, is the fibre from the sheathing bases of the leaves of a palm (*Attalea funifera*), and is a most valuable material for the manufacture of bass brooms and brushes. A similar product, obtained from Para, is furnished by another palm, the *Leopoldinia piassava*. In consequence of the scarcity of these two commodities, attention has of late years been directed to other channels for substances that might compete with, or, at any rate, be used as a substitute for true piassava. One has been found in Madagascar, the fibres of which are, however, not sufficiently stiff or elastic to be used by themselves Split cane, dyed brown to resemble piassava, has also been used, more, perhaps, for mixing with the real thing than to be used alone. But the most recent introduction, and one of very considerable importance, is that now known in commerce as African piassava, or Lagos bass. It differs from the other three kinds, inasmuch that, instead of being a fibrous coating or sheathing at the base of the leaves, it is the strong woody fibres of which the petiole, or leaf stalk, are built; and as the palm (*Raphia vinifera*) is now abundant in tropical Africa, the supply is practically inexhaustible. With this consideration, coupled with the fact that the substance continues to arrive in large quantities, and to meet with a very ready sale, it may be taken that African piassava is one of the most important of newly discovered vegetable products.

— The British East Africa Company have determined to make a complete survey of the district between the east coast of Africa and Victoria Nyanza, the vast inland sea. The idea of having a railway to this lake has been discussed for some time, and Sir John Fowler, on being appealed to, gave it as his opinion that a railway was practicable, and need not cost over two millions sterling. This opinion, of course, could only be formed on incomplete information, for while travellers, like Mr. Joseph Thomson, who has just returned from the interior of Africa, Dr. Fischer, and Count Teleki, have afforded information as to the nature of the country to be traversed, little is known about the formidable Mau escarpment and the country lying between that precipice and the lake. A thorough survey is therefore desirable, and the British East Africa Company, with commendable enterprise, have determined to send out a party, the chief of which will be Captain J. R. L MacDonald, with Captain J. W. Pringle as assistant, both being officers of the Royal Engineers. Captain MacDonald is attached to the Indian Public Works Department, and has had much experience of railway surveying in India. The surveying party will leave England in about ten days, says *Engineering* of Oct. 30, and on arrival will separate into two or three sections. One party will proceed along the Sabaki River, and the other will start from Mombasa. Both will meet up the Sabaki and explore both banks. From Machakos the party will separate into three parties. The return will be *via* the Kampéplain so that eight months will probably be occupied in the work. It is hoped that the result of the survey will be the construction of a railway to the shores of the lake, as by this means it will be possible to open up a very large tract of virgin country for trading purposes. But we do not know that the opinion will be equally unanimous as to the railway being made by the government. The British East Africa Company will profit most largely, and surely they should bear the financial risk, if there be any. In any case the survey must have valuable results, as it will afford definite information of that part of Africa, regarding which so little is known and in which so much interest is taken.

— Positive photographs can be obtained direct from the camera, as announced by J. Waterhouse, in "Eder's Jahrbuch," 1891, 283–287 (abstract in *Zeitsch. Physik. Chemie*, VIII., 567). This remarkable result is secured by adding small quantities (about one-fifth per mille) of a substituted sulpho-urea to the developer. Experiments were made with allyl and phenyl sulpho-urea added to eikonogen. Sulpho-urea itself acts similarly, but without satisfactory results. All these substances are powerful accelerators.

— A very simple method of laying the foundations on a swampy location, which did not furnish a firm subsoil, was employed by an American engineer, according to *Engineering*, for supporting a low wooden building to be used for storage of machinery. Casks were set in holes in the ground along the line of posts and were filled to the depth of about one foot with iron turnings. The posts were set in the casks, which were then filled with iron turnings compactly rammed in place. A solution of salt and water was then slowly poured over these turnings, which compactly solidified into a hard mass. The heat of the oxidation of the iron was so great that the posts smoked and were charred; the latter fact probably being the reason why they have not as yet exhibited any signs of decay; and in this respect the use of iron turnings furnishes an advantage over the use of concrete for cask foundations.

— Perhaps the strangest instance of the forced wanderings of a petrel was that which brought one of the last-known members of an extinct, or at any rate a lost species, the capped petrel, whose only home appears to have been the islands of St. Domingo and Guadaloupe, from the West India seas to a Norfolk heath. In March or April, 1850, according to the *London Spectator*, Oct 31, a bird was seen by a boy on a heath at Southacre, in Norfolk, flapping from one furze-bush to another, until it crept into one, and was there caught by him. Exhausted as it was, it violently bit his hand, and he thereupon killed it. A Mr. Newcome, one of a race of falconers, happened to be hawking in the neighborhood, and his falconer, seeing the boy with the dead bird, brought it to his master, by whom it was skinned and stuffed, and placed in the Newcome collection, where it still remains. It was a large bird, about sixteen inches in length, with long, curved wings characteristic of all the petrels, and a black head, as its name indicates. Only two other instances of the capped petrel's appearance in Europe are known. One was shot near Boulogne, and one in Hungary, in 1870, which is in the museum at Buda-Pesth. Two others have been taken in the United States. But the strangest part of the story is that the capped petrels are now either extinct, or lost to the knowledge of man. "It is certain," says Mr. Stevenson, in his last and unfinished volume of "The Birds of Norfolk," "that the true home of this very rare species is, or was, in the islands of Guadaloupe and Dominica, in the West Indies, where it was formerly very abundant; but one of its old breeding-places in the last-named of these islands was explored, without finding a single bird, in February, 1887, by Colonel Feilden." It appears that ten years before, not only Dominica, but also Guadaloupe, was searched in vain for the "Diablotins," the name by which these petrels were known to the old voyagers. It is believed that they were possibly destroyed by a South American opossum which was introduced to the island; but as the young and even the old birds were constantly caught by the islanders for food in the holes in which they nested, their destruction may be due, like that of the great auk, to human greediness.

— Morgan R. Sanford, formerly of the Kansas Wesleyan University, has been elected professor of science in the school at Wilbraham, Mass.

— Mr. Charles Darwin of the United States Geological Survey has been appointed to investigate the tin mining industry of California, and has already proceeded to the scene of operations.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full. so that answers will go direct to them. Th "Exchange" column is likewise open.

MADSTONES AND THEIR MAGIC.[1]

FOR centuries many accounts have been current regarding the virtues, real or imaginary, of certain bodies known as snake stones and madstones, which are asserted to have the power of absorbing poisons from wounds. The literature of two hundred years ago contains references to these substances; and even now some persons have a lingering belief in their efficacy. The subject is a curious one, and a brief account of it may be of interest, particularly of the origin and identification of one of these peculiar bodies.

Jean Baptiste Tavernier, the great oriental traveller of the seventh century, in his "Travels in India" (see Dr. Valentine Ball's translation in two volumes, London and New York, 1889, pp. lxx. 429; xix. 496) says: "I will finally make mention of the snake stone, which is nearly of the size of a double doubloon (a Spanish gold coin), some of them tending to an oval shape, being thick in the middle and becoming thin toward the edges. The Indians say that it grows on the heads of certain snakes, but I should rather believe that it is the priests of the idolaters who make them think so, and that this stone is a composition which is made of certain drugs. Whatever it may be, it has an excellent virtue in extracting all the poison when one has been bitten by a poisonous animal. If the part bitten is not punctured, it is necessary to make an incision so that the blood may flow; and when the stone has been applied to it, it does not fall off until it has extracted all the venom, which is drawn to it. In order to clean it it is steeped in woman's milk, or, in default of it, in that of a cow; and after having been steeped for ten or twelve hours, the milk, which has absorbed all the venom, assumes the color of madder. One day when I dined with the Archbishop of Goa, he took me into his museum, where he had many curiosities. Among other things he showed me one of these stones, and, in telling me of its properties, assured me that it was but three days since he had made a trial of it, after which he presented it to me. As he traversed a marsh on the island of Salsette, upon which Goa is situated, on his way to a house in the country, one of his palanquin bearers, who was almost naked, was bitten by a serpent, and was at once cured by this stone. I have bought many of them, and it is that which makes me think that they make them. You employ two methods to ascertain if the snake stone is good and that there is no fraud. The first is by placing the stone in the mouth, for then, if it is good, it leaps and attaches itself immediately to the palate. The other is to place it in a glassful of water, and immediately, if it is genuine, the water begins to boil."

Thevenot says, in his "Voyages," p. 94, that snake stones were made of the ashes of the root of a certain plant, mixed with a particular kind of clay. Some snake stones appear to have been made of charred bone (see, for an exhaustive account of this subject, Yule-Burnell, "Anglo-Indian Glossary"). The belief in their efficacy is still very general in India; by some they are supposed to be found in the head of the adjutant bird (see "Jungle Life in India," p. 83).

Francisco Redi describes, in his "Experimenta" (Amsterdam, 1685, pp. 4 to 8), the extraordinary healing power attributed to stones obtained from the heads of certain serpents, called by the French "cobras de capello," found throughout Hindostan and Farther India. These stones are claimed to be an infallible remedy for the bites and stings of all kinds of venomous reptiles or animals, and likewise for wounds made by poisoned arrows, etc. He repeats the usual tales of their adhering powerfully when applied to the bite or wound, and clinging to it like a cupping-glass until they had absorbed all the poison, when they would fall off spontaneously, leaving the man or animal sound and free. Then follows the account of steeping the stones in milk to remove the poison, the milk assuming a color between yellow and green. These wonderful stones and the narrations concerning them had been brought to Italy by Catholic missionaries, who seem to have entire faith in their powers; so that Redi says they offered to prove the accounts by any number of experiments, such as would satisfy the most incredulous, and prove to medical men that Galen was correct when he wrote (chapter xiv. book I.) that certain medicines attract poison as the magnet does iron. For this purpose a search for vipers, etc., was recommended; but, owing to the season being later and colder than usual, none could at that time be obtained, as they had not emerged from their winter quarters. An experiment was therefore substituted, after much consultation among the learned men of the Academy of Pisa, whereby oil of tobacco was introduced into the leg of a rooster. This was regarded as one of the most fatal of such substances, and was administered by impregnating a thread with it to the width of four fingers and drawing it through the punctured wound. One of the monks forthwith applied the stone, which behaved in the regular manner described. The bird did not recover, but it survived eight hours, to the admiration of the monks and other spectators of the experiment.

Redi states that he himself possessed some of these stones, and also Vincent Sandrinus, one of the most learned herbalists of Pisa. Redi describes them as "always lenticular in form, varying somewhat in size, but in general about as large as a farthing, more or less. In color some are black, like Lydian stone, tinged at times with a reddish lustre; others white, others black, with an ashy hue on one side or both," etc.

Up to the present time no one has apparently identified what Tavernier referred to in speaking of snake stone. It, however, occurred to the writer, after receiving a quantity

[1] This article also appeared in the New York Sun.

of tabasheer from Dr. F. H. Mallet of the Geological Survey of India, who obtained it at the bazaar of the Calcutta Fair in November of 1888, that the Indian snake stone is evidently tabasheer. Tabasheer is a variety of opal that is found in the joints of certain species of bamboo in Hindostan, Burmah, and South America; it is originally a juice, which by evaporation changes into a mucilaginous state, then becomes a solid substance. It ranges from translucent to opaque in color. I found it either white or bluish-white by reflected light, and pale yellow or slight sherry red by transmitted light. Upon fracture it breaks into irregular pieces like starch. As in Tavernier's account of its clinging to the palate and causing water to boil when immersed, it actually has the property of strongly adhering to the tongue, and when put into water emits rapid streams of minute bubbles of air. It has a strong siliceous odor, but after absorbing an equal bulk of water becomes transparent like a Colorado hydrophane described by the writer several years ago before the New York Academy of Sciences.

Although tabasheer is mentioned in nearly all the text-books, very little of it has reached the United States. It is highly interesting, since we have here an organic product scarcely to be distinguished from a similar opal-like body found by Mr. Arnold Hague in the geysers of the Yellowstone Park. Both tabasheer and the hydrophane were probably what was called "Oculus Beli," "Oculus Mundi," and "Lapis mutabilis" by Thomas Nicol, Robert Boyle, and other writers of the seventeenth century, and "Weltauge" by the Germans.

The great capacity of this substance for absorbing a fluid would undoubtedly render it as efficacious for the purpose of absorbing poison as any other known stone, providing the wound is open enough; and its internal use to-day as a medicine is possibly also due to this property.

Tabasheer, as known among mineralogists, is a corruption of the word tabixir, a name which was used even in the time of Avicenna, the Grand Vizier and body surgeon of the Sultan of Persia in the tenth century. It played a very important part in medicine during the middle ages. As to its origin, Sir David Brewster[1] says that tabasheer is only formed in diseased or injured bamboo joints or stalks.

Guibourt[2] differs from Brewster, inasmuch as he attributes the different rates of growth to the fact that when there is a superabundance of sap the tabersheer is formed from the residuum. More recently, Henry Cecil[3] says, "In the onrush of tropical growth in the young shoot, nature, after flooring the knot, has poured in, as it were, sap and silica sufficient for a normal length and width of stem to the knot next above it. But by some check to the impulse, or by irregularity of conditions, the portion of stem thus provided for is shorter or narrower than intended, and the unused silica is left behind as a sediment, compacted by the drying residuum sap."

This latter view is sustained by Dr. Ernst Huth in his elaborate description of this substance, entitled "Der Tabixir in seiner Bedeutung fur die Botanik, Mineralogie, und Physik; X. Sammlung Naturwissenschaftlicher Vortrage, herausgegeben von Dr. Ernst Huth, Berlin, 1887."

In this article Dr. Huth discusses the name, history, origin, and reputed virtues of this substance with much fullness. In regard to its use in medicine during the middle ages, he quotes a remarkable list of applications to the ills that flesh is heir to.

Here it is cited as a remedy for affections of the eyes, the chest, and of the stomach, for coughs, fevers, and biliary complaints, and especially for melancholia arising from solitude, dread of the past, and fears for the future. Other writers speak of its use in bilious fevers and dysentery, internal and external heat, and a variety of injuries and maladies.

The writer has examined a large number of so-called madstones, and they have all proved to be an aluminous shale or other absorptive substance. But tabasheer possesses absorptive properties to a greater degree than any other mineral substance that I have examined, and it is strange that it has never been mentioned as being used as an antidote. It may be confidentially recommended to the credence of any person who may desire to believe in a madstone.

GEORGE FREDERICK KUNZ.

[1] Edinburgh Philos. Journal, No. 1, p. 147; Philos. Trans., cix., p. 283; and "The Natural History and Properties of Tabersheer," 1828; Edinburgh Journal, viii., p. 288.

[2] Jour. de Pharmacies, xxvii., pp. 81, 161, 252; and Phil. Mag., x., p. 229.

[3] Nature, xxxv., p. 437.

THE PLANT-BEARING DEPOSITS OF THE AMERICAN TRIAS.[1]

THE plant-bearing deposits of the American Trias are, so far as known, confined to two general regions, viz., a series of troughs in the piedmont region of the Atlantic slope extending from Massachusetts to North Carolina, and a great basin or area in the territories of New Mexico and Arizona. The character and structural relations of these rocks have been fully discussed by numerous writers. It is proposed in this paper to examine the evidence of the fossil plants as to their geological position. This evidence may be considered from two points of view; first, as to the relative position of the several basins, areas, or plant-bearing portions; and, second, as to the general relations of the flora as a whole to other floras which resemble it sufficiently to admit of comparison.

In looking at the subject from the first of these two points of view, or that of the American distribution, it is convenient to divide the general terrane into five geographical areas corresponding nearly with so many geological basins, viz., first, that of the Connecticut valley; second, the area that extends with little interruption from the Hudson River to near Charlottesville, Virginia; third, the Richmond coalfield; fourth, the North Carolina coalfield; and, fifth, the western area, which is not as yet sufficiently known to admit of subdivision.

The fossil plants have nearly all been found in the Connecticut valley, the Richmond coalfield, the North Carolina coalfield, and about the copper mines of New Mexico; a few came from New Jersey, Pennsylvania, and Maryland, while only silicified trunks have thus far been discovered in Arizona. All the material that has been found has been carefully studied and as accurately determined as its nature will permit. The greatest abundance of vegetable remains occurs in the Richmond and North Carolina coalfields.

A careful comparison of all the forms shows that out of a total of a hundred and nineteen species eighty-five are confined to some one of the areas above enumerated, leaving only thirty-four that occur in two or more of them. Tables of the distribution of species with full analysis of their relations and significance are given in the paper. As a general result, it is found that none of the basins except that of the

[1] Read by title, by Lester F. Ward, before Section E of the American Association for the Advancement of Science, at Washington, D.C., Aug. 21, 1891; and in full before the Geological Society of America, at the same place, Aug. 24, 1891.

west contains less than thirty-nine per cent of species common to it and some one or more of the other basins, and that one of them, viz., that of New Jersey and Pennsylvania, has seventy-two per cent of its plants common to other basins, while that of North Carolina has fifty-two per cent, and that of Virginia thirty-nine per cent. All who are familiar with the evidence from fossil floras must therefore admit that it is strongly in favor of the general parallelism of the four eastern basins, while the minerals are too scanty to base a safe conclusion upon relative to the great western area with fifteen per cent of its species common to it and the eastern deposits.

Considering the subject from the second point of view above mentioned, or that of the foreign distribution, it is found that forty of the hundred and nineteen species occur in other deposits of the world, while seventeen others are represented elsewhere by closely related forms, giving fifty-seven of what may be termed diagnostic species. Omitting all details as before, it appears that the largest number of these, viz., thirty-two, occur in beds that have been authoritatively referred to the Keuper of Old World nomenclature, the Rhetic coming next, with thirty-one, followed by the Lias with twenty, and the Oolite with nineteen.

The general conclusion, therefore, is that, so far as the evidence from fossil plants goes, the precise horizon, relatively to the European deposits, of our American older Mesozoic plant-bearing rocks must be at the summit of the Triassic system, with their nearest representatives in the Keuper of Lunz in Australia and at Neue Welt near Basle, in Switzerland; while there is also a close affinity in the types to those of the Rhetic of Franconia and South Sweden.

BIRDS IN HIGH GALES.

At first it seems difficult, says the *London Spectator*, Oct. 31, to believe that the petrels, gifted with such powers of flight that, like their first cousins, the albatrosses, they make the central ocean their chosen home, should so far succumb to the Atlantic storms as to fall wholly under the dominion of the wind, and drift for thousands of miles to unknown and inhospitable shores. But any one who has watched the flight of a "lost" bird in a gale on land may form some idea of the danger to which the petrels are exposed when a hurricane bursts in the Atlantic.

Near Oxford, when the last gale was at its height, the writer was watching the "centre-board" rushing up and down over the floods on Port Meadow, with a strong current and the wind on their quarters; the geese were flying over the flood to avoid the canoes and small craft; and the wind was blowing a full gale from the south-west, with a brilliant sun, occasionally hidden by a white, drifting cloud. Far away to the north was a long-winged bird, beating up against the wind. At one time it rose high in the air, facing the gale; then it descended with a rapid swoop progressing westwards, but at the same time "falling off" still further to the north. It was a young herring-gull, its checkered gray-and-white plumage showing clearly in the bright light as it approached. It was easy to conjecture from the gull's flight the power of storms to drive birds from the course which they aim at. The bird's point was clearly westward. It used every shelter and every lull of the wind to make it; but the gale was two powerful, and it appeared that it must either stay on the inhospitable land until the wind dropped, work its way slowly to the west with a rapid drift to the north, or abandon its struggle and drift with the wind.

But all birds seem to have an instinctive knowledge that if they once surrender to the force of the wind, and allow themselves to drift like leaves, there are unknown dangers in store for them. They will hardly ever do so unless to escape pursuit, and then only for a few minutes, when their pace is so marvellously rapid that, in the case of land-birds, a few minutes is sufficient to carry them out of the district they know into others from which they will perhaps never be able to find their way back to the fields which are their native home.

In the gale on Sept. 1 of the present year the writer saw a successful effort made by partridges to avoid the consequences of thus abandoning themselves to the gale. A covey of very strong birds, which had been hatched on the highest part of the Berkshire Downs, was flushed downwind, and, rising high in the air, the whole brood were carried in a few seconds to the extreme edge of the hill, below which was a sudden fall of some three hundred feet to a country quite unknown to these hill-birds. As they approached the limit of their own district, the partridges made an extraordinary effort to release themselves from the power of the wind, and to avoid being forced over the hill-top. Closing their wings, they sank almost to the ground, and so gained the slight shelter of a low bank. This enabled them to wheel, and so to face the gale. Even then they might not have achieved their object had not a small thorn-bush broken the force of the wind just on the edge of the down. The whole covey used the respite so given, and skimming up almost in single file, they alighted one by one behind the bush, on the extreme limit of their native ground. But recent instances are not wanting in which partridges have been carried out to sea when drifting on the wind. At Sizewell, in Suffolk, nine partridges were blown out to sea, and dropped in the water some four hundred yards from the shore; and in another case thirteen of the "red-legged" variety attempted the flight across the estuary of the Stour, and, falling exhausted, were picked up by some boatmen fishing for "dabs," a welcome and unlooked-for haul.

ASTRONOMICAL NOTES.

The *English Mechanic* of Oct. 30 is authority for the statement that Dr. Hind, the superintendent of the English Nautical Almanac, will be succeeded by Mr. A. M. W. Downing, one of the chief assistants at the Greenwich Observatory, of which fact mention was made in a recent number of *Science*. The change will take place at the commencement of the coming year.

In *Knowledge* for November are given reproductions of four photographs, taken from a baloon by Mr. C. V. Shadbolt, in England. The several photographs were taken at a height of 500, 1,500, 2,100, and 6,000 feet, respectively. We understand that Mr. Shadbolt is the first to secure at these altitudes a recognizable plate.

Fathers Hagen and Fargis, astronomers connected with the Georgetown, D.C., Observatory, have just published a paper entitled "The Photochronograph and its Application to Star Transits." The aim of these gentlemen has been to secure an instrument that would photograph the transit of a star across the meridian. A reproduction of the transit of Sirius, as photographed, is given as an illustration of the work performed. In brief, the instrument these gentlemen have contrived consists of an electro-magnetic shutter, or "occulting bar," which is secured to the eye-end of the transit instrument. The apparatus is so formed that the current pressing through a break circuit clock moves the occulting bar every second in such a way that the image of the star is for the instant allowed to form on the photographic plate behind this bar. The impression left by the star in transit is a row of dots, which are afterwards developed in the usual way. These dots are referred to the collimation axis of the telescope by means of a glass reticule plate, ruled with one vertical line. This plate is permanently fixed in the tube, directly in front of the sensitized surface, and touching it. After the star transit is over, the light from a lantern is allowed for a few seconds to fall upon the photographic plate, which gives an impression of this reference line. The row of dots which have just been photographed can not be "fogged" by this light, as they are shielded behind the occulting bar. After the plates are developed they are measured by the aid of a micrometer.

In the *Monthly Notices of the Royal Astronomical Society* (LI., No. 9), Professor Barnard of the Lick Observatory gives the result of his observation of Jupiter and his satellites during the year 1890, made with the 12-inch equatorial. One of the most interesting points in his paper is the fact that he saw the first satellite elongated in a direction nearly perpendicular to the belts of Jupiter. This observation was made on Sept. 8, 1890, when both Mr. Barnard and Mr. Burnham saw the satellite distinctly double. The distance between the two images was about 1″, and at a position angle of 173°. Mr. Barnard gives two drawings, which represent the object as it appeared on two different dates. Two explanations are suggested. The first is that the satellite at the time of observation was crossed by a white belt parallel to those on Jupiter, or, second, that the satellite is actually double. We are strongly of the opinion that Mr. Barnard has solved his problem in his first assumption. This is explained in an article written subsequent to the one from which we have quoted. His assumption is that the satellite is crossed by a white belt, the remaining portion of the disk being dark. Now, should an object of this character transit a bright portion of Jupiter's surface, we would have the effect of two small, dark disks close together, which would appear round on account of irradiation and glare from such a bright object as the large planet. As the little moon passed across the face of Jupiter, the bright belt on the former would be lost in the bright surface of the latter. Now, if the satellite were to transit a dark portion of Jupiter's surface, we would have the opposite effect, that is, a white spot elongated in a direction parallel to the dark portion of Jupiter's surface on the large planet. Mr. Barnard, in the early fall, has reobserved these phenomena, and has found both of the conditions above mentioned fulfilled. However, these observations are very interesting, and only go to show that some of our large telescopes can be put to a good use in determining the markings on the satellites surrounding Jupiter, and assist in determining their period of rotation.

The following are the positions for comet Tempel-Swift. They are given for Paris midnight.

Date.	R. A. h.	m.	s.	Dec. °	′
Nov. 23	22	52	41	+17	22
25	23	4	6	18	27
27		16	9	19	30
29		28	48	20	33
Dec. 1	23	42	1	+21	34

The comet will reach its maximum degree of brightness on Nov. 23.

The following are the positions for Wolf's comet. They are given for Greenwich midnight.

Date.	R. A. h.	m.	s.	Dec. °	′
Nov. 18	4	32	53	−9	58
20		31	35	10	38
22		30	16	11	14
24		28	55	11	47
26		27	35	12	19
28		26	15	12	46
30	4	24	57	−13	11

The comet has now reached its nearest approach to the earth.

G. A. H.

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.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The Man of the Future.

IN his criticism of my contribution to *Science* (Oct. 16) entitled "The Man of the Future," which was called forth by a former letter from Dr. Langdon (No. 452), Mr. Snell has expressed his views on the subject with great fulness and clarity (*Science*, Nov. 6). In several instances, however, the present writer can in no way agree with him, and as those points of disagreement are of prime importance, they will be briefly dwelt upon here. When Mr. Snell says that "The problem of human progress seems to have a fivefold aspect, physical, material, social, moral, and intellectual; and it therefore involves questions belonging to sciences as widely divergent as physiology, technology, sociology, and psychology" (p. 259), we must believe that biologists, as a rule, will not be fully in accord with him in the statement. Granting for the nonce that human progress has such a fivefold aspect, surely the consideration of his "physical" progress falls within the science of morphology rather than that of "physiology"; the "material" progress of man is quite secondary to the question at issue, and it hardly seems to be encompassed by the restricted science of "technology"; finally, strictly speaking, "psychology" is but a department of physiology, as sociology is of biology, and consequently both those sciences properly fall within the province of biology for treatment. Every biologist being more or less familiar with the factors in operation in the premises, we take it that the main object of the present discussion has to do more with a speculation upon the probable morphology of the man of the future, rather than it has to do with a discussion of the aforesaid factors, though undoubtedly in some instances it will be desirable to make somewhat extended reference to them.

As Mr. Snell remarks, he has not far to seek to find excellent authority to support his statement that "Although in the subhuman state the environment may have made the man, in the human state the man, generally speaking, makes his environment." But surely if this factor be in operation at all, which I do not fully deny, it is purely an exceptional one, and by no means the rule. In our estimation, it has been very much overrated by biologists. Take, for example, the ferine tribes the world over,—in what way do the majority of them "make their environment" any more than do the individuals in a community of beavers? Many tribes, apart from the mere possession of speech, pass an existence quite comparable with the lives led by some of the lower mammals in a state of nature. Coming up to the so-called semicivilized races of the earth, the same principle in the main still holds true, although operative upon a somewhat higher plane. One may as well assert that the average Turk "makes his environment," and we may ask in what particular? If it be that he makes it, I, for one, should like to see the experiment of his attempting to step out of it. He probably would feel very much as the monkey does on the hand-organ or in the menagerie. Even in a highly civilized nation like our own, few there be indeed who really understand what organic evolution means, much less to bring its laws into operation in an intelligent manner, so as to shape their own environment thereby, to the end that they keep upon the sole narrow track of true human progress. Improvement in education and its methods; improvement in human sanitation,— wear to me more and more the aspect of kinds of growths which man no more possesses the power of checking than he possesses the ability to stay the extinction of animals in nature, or even to arrest biologic evolution its very self.

The lesson taught us by the half-tried experiment in human stirpiculture by the Oneida Community was not, or rather should not be, entirely thrown away, nor do I believe that that experiment proved to be altogether a failure. To test its worth as a mode of race improvement it should be tried upon a much larger scale, in the fuller light of our more advanced scientific knowledge, and with the element of artificial selection not left out.

On the other hand, I cannot agree with our distinguished savant Professor Joseph Le Conte when he says that "if we are to have any race-improvement at all, the dreadful law of destruction of the weak and helpless must, with Spartan firmness, be carried out voluntarily and deliberately" (*The Monist*, vol. i., No. 3, Apr., 1891, p. 334); for I believe that it requires but a rigid enforcement of a law that will prevent the marrying of such individuals or their reproducing their kind at all, to soon bring about the desired result. While civilized man may be "making his own environment," he certainly is not taking any rational steps at present to improve the race in that direction,— one of the most important of all. In ages to come I have an idea that such matters will be scientifically dealt with, and they were in my mind when I discussed the "man of the future" in my letter to *Science*, whereas Mr. Snell was surely dealing with the man of the present when he remarked upon this aspect of the case, that "the plan is fraught with collateral difficulties, and, even if these could be overcome, it seems to be forever out of the question, on account of the moral impossibility of obtaining for it, under any conceivable circumstances, the sanction of public opinion" (p. 259). And, assuredly with the man of the past when, in taking exception to my prediction of the abolition of war, he makes the somewhat isolated statement that "Chateaubriand, in his pamphlet 'De Bonaparte et des Bourbons,' calculated that more lives had been lost during the Napoleonic wars than during the whole of the Middle Ages throughout all Christendom."

That long and destructive wars are gradually becoming less and less frequent seems to me to be but a matter of comparative history. National differences are now often adjusted without resort to bloodshed, which only a century or more ago would most certainly have given rise to a resort to arms. In short, warism and all that pertains to it is a relic of savagery, and with savagery must, in time, disappear.

The realization of this prediction, taken in connection with the disappearance of widespread and fatal epidemics of disease, which are likewise becoming less and less frequent, must of necessity have a powerful influence on the man of the future. By their elimination the world will certainly be more thickly and more quickly peopled with the human species. Mr. Snell has said nothing in his communication that has had a tendency to alter my opinion in reference to the destruction of the world's fauna and much of its present flora. I cannot conceive that "any portion of the flora or fauna of the globe which has even a picturesque or decorative value" as now existing, is destined to be seen by the "man of the future," and alone represents the share which is not doomed to be destroyed. Possibly your correspondent would have me believe that some time in the future the day will arrive when all the habitable part of the globe will have been converted into one continuous, immense park, combined with biological preserves and enormous areas of dwellings and other habitations for the men of the future! It depends very much what is meant by the expression "picturesque or decorative value," for to my mind biologic, and in face of the geological history of the world as now known to us, such an outcome is simply out of the question. To me, for example, there is no doubt but that the present existing avifauna of the world, or rather the entire group of those now highly specialized forms we call birds, are destined to become utterly extinct in nature in the future history of the earth, and yet they certainly possess a certain "decorative value." The largest or larger forms will first disappear, to be followed gradually by all those of less and lesser size. Our own avifauna is amply illustrative of this fact.

My critic said much in the leading paragraphs of his long communication that pleased me greatly; I refer especially to his remarks upon the growth of education; upon questions ethical and metaphysical; upon problems social and psychological, and upon morals; but I confess to my utter disappointment when I came to read further along in his article that he entertained such notions as "neither our senses nor our memories are as acute as those of our barbarian ancestors; our taste and capacity for intellectual speculation is not as great as was possessed by our predecessors of the scholastic period, or by the South Asiatic Aryans of any historic time;" and finally the statement, so tinctured with pessimism, that "the low vice of avarice rules the day." Were these statements true for the present hour, there could hardly be any doubt as to what some of the characteristics of the man of the future must be.

Mr. Snell unconditionally surrenders both sword and pen when he concludes by saying, "I cannot venture, in view of the complexity of the problem, to hazard a prediction even for the next stages of human evolution, to say nothing of the millions of years over which Dr. Shufeldt so gaily gambols." Why, human "evolution" is the very pith of the question we are considering, and we biologists believe that we have so far solved the riddle of the origin of life upon earth, and the growth and development of animal and vegetable forms since, and the laws that control the same, that it is quite a pardonable thing for us to do, even if it be of "doubtful utility," to forecast the fate of any vertebrated animal, man not excepted, into the future. A nineteenth century biologist, such as I am, is not likely to take umbrage at being charged with "gambolling over millions of years," for I am become already callous to the charge of "gambolling" too many millions of years in the other direction, or into the *past*, in seeking into the question of the *origin of man* there. Indeed, I take no little pride in the fact that during the last ten years I have from time to time, as far as my poor ability would allow me, lent both my voice and pen to the view that man arose upon earth at a far remoter period in its history than a few *thousand* years amount to, as many eminently good people would yet have us to believe. R. W. SHUFELDT.

Takoma, D.C., Nov. 17.

The International Geological Congress.

THE month of August, 1891, witnessed a remarkable gathering of scientific bodies at the capital. No less than nine organizations engaged in pursuits of a scientific character met in convention in Washington. From the 10th of August to the 2d of September the following bodies held meetings, partly successive and partly contemporaneous: the American Microscopical Society; the Association of American Agricultural Colleges and Experiment Stations; the Association of Official Agricultural Chemists; the Society for the Promotion of Agricultural Science; a conference of American chemists, with the Washington Chemical Society; the Association of Economic Entomologists; the American Association for the Advancement of Science; the Geological Society of America; and the Fifth International Congress of Geologists.

As one who enjoyed the privilege of attending and participating in the three last-named gatherings, I have brought together a few memoranda of some of the many points of interest connected therewith, especially in the department of geology.

The Association for the Advancement of Science, instead of continuing for a week, as its custom has been, closed its fortieth session on Saturday, Aug. 22, and gave up the Monday and Tuesday following to the American Geological Society. During the year previous, death had removed from the list of American geologists three eminent names,— E. W. Hilgard, Joseph Leidy, and Alexander Winchell, the last of whom was the president of the society for the year. The opening paper was a beautiful tribute to his work and worth, by his brother, Professor N. H. Winchell of Minneapolis.

One of the most interesting matters presented at these meetings was the paper of Mr. Charles D. Walcott on the discovery of undoubted fish-remains in strata of Ordovician (Lower Silurian) age, near Cañon City, Colorado. The occurrence of fishes in Upper Silurian beds has long been known in Europe, and in a few cases in this country; but it was a novel, and almost startling, change in our ordinary ideas to see these specimens of abundant ichthyic remains,—chiefly small granoidal plates and scales,—from a horizon corresponding to the Trenton limestone of the East.

The library of the Columbian University was converted into a room for geological exhibits, in which were arranged a very large number of specimens and appliances of much interest. The United States Geological Survey furnished a host of maps, reports, reliefs, photographs, etc., illustrating important features of American geology and the extensive character of the work in progress therein. Numerous maps and volumes were likewise displayed by State surveys, and by individual geologists; while many remarkable specimens and suites of specimens occupied table-cases throughout the room. Among these may be mentioned an extensive series of American rocks, brought by the representatives from that country; the Ordovician fish-remains above referred to, by Mr. Walcott; a most beautiful suite of the Tertiary insects from Florissant, Colorado, named and described by Professor Scudder; and, of peculiar interest, what appeared to be unquestionably glacial groovings from a Silurian rock-surface, exposed on removal of overlying strata,—thus indicating a glacial epoch far back in early Paleozoic time. These specimens, with views of the spot, were from a Scandinavian locality. Most of this interesting material was recorded in a pamphlet "Catalogue of Exhibits."

The general plan of the Geological Congress was to take up, for each day of the session, some one comprehensive subject, and after a full treatment of it by one or two members, to discuss it broadly and compare views, but not to attempt to decide upon mooted questions. This method was the result of experience in past meetings of the Congress, wherein it has come to be seen that little is gained by the attempt to pass judgment or formulate rules. Another interesting point was that, by general consent, the lead was taken by, or rather given to, our own geologists,—the foreign delegates, while participating largely in the discussions, coming to see, and hear, and learn.

The first subject was the classification of Pleistocene (Quaternary) deposits. The opening paper was by president T. C. Chamberlain, and was a comprehensive and exhaustive scheme of genetic classification of all the forms and types of superficial deposits immediately preceding the present period. The second day was given to the topic of cerrelation of sedimentary rocks, and was opened at length by Professor G. K. Gilbert of the United States Geological Survey, who described the several methods, both physical (by structure) and biotic (by fossils) available in identifying and correlating rocks. The discussion on this topic became very extended, going over into the next day, and was of great interest, in that many specialists in different departments presented their methods of work and their estimates of various means. Thus Professor von Zittel dwelt on the advantages of marine invertebrates, as compared with higher forms, or correlation; Professor Cope took up the gauntlet in behalf of vertebrata; and Dr. Lester F. Ward for fossil plants; while the physical methods of correlating and classifying strata were discussed by Professor McGee in an exposition of what is sometimes termed "the new geology," as applied to the coastal region of the Atlantic States, and by Professor Van Hise in a discussion of the great pre-Columbian series, now coming to be recognized and traced in the United States, under the name of Algonkian. The general view, however, emphasized the fact that all methods of correlation vary in value inversely as the geographical distance of the beds.

The next day was given to map-coloring and cartography. Here Major Powell, the head of the United States Geological Survey, naturally led the discussion, presenting a full account of the scheme adopted for the work of the survey, which is quite different from that proposed in 1885, at the Berlin meeting of the Congress. In the subsequent discussion, one fact, very strikingly developed, was the vastness of the scale on which the work of the American survey is conducted, as compared with those of Europe.

Indeed, this same aspect came often and strongly to view during the summer,—the immense field of geology in America, the vast areas to be connected and compared, the possibility of both methods and results, when "the whole boundless continent,"—of simple structure, and under a single government,—is to be dealt with, that are different from those of the Old World,—broader, grander, and more comprehensive. D. S. MARTIN.

New York, Nov. 14.

Fifth International Congress of Geologists.

IN the current number of your journal (Nov. 6, 1891) is an article presenting Dr. Persifor Frazer's views upon the recent meeting of the International Congress at Washington. Dr. Frazer is of course at liberty to entertain such opinions with regard to the congress as he pleases, but in presenting an elaborate statistical table, as he has done here, he should at least endeavor to obtain accurate data.

Printed lists of names and addresses of members who had registered up to the fourth day of the congress were freely distributed to all who took part in the meetings. Some few belated foreigners registered after that date. Dr. Frazer's table ostensibly gives the comparative attendance at the five congresses, although he himself admits that no statistics have been given showing the actual attendance at the Paris congress. For the Washington congress he gives an attendance of 148 natives and 58 foreigners, as against 172 natives and 75 foreigners given by the printed lists above mentioned. Hence, of the four conclusions which he draws from his table, in point of fact all are incorrect, with the possible exception of the last, which I have not yet had time to verify. S. F. EMMONS.

Washington, D.C., Nov. 12.

AMONG THE PUBLISHERS.

EARLY in 1892 Houghton, Mifflin, & Co. will publish under the title of "The Spirit of Modern Philosophy," the lectures given by Dr. Josiah Royce of Harvard in Cambridge last winter. The lectures were listened to with great interest, and, having been carefully revised, will form a work of remarkable value.

—Little, Brown, & Co. have nearly ready a new edition of Nuttall's "Hand-book of American Ornithology," brought down to date by Montague Chamberlain.

—A "Supplement to the Hand-Book of the American Academy" has just been published. It contains a list of the accessions to membership in the American Academy of Political and Social Science from Apr. 15 to Aug. 15, 545 names in all.

—Dextrine is the best substance for gumming labels. It may be purchased of almost any wholesale manufacturing chemist. It is mixed and stirred with boiling water until it obtains a consistency like ordinary mucilage, then applied to the back of the printed matter with a wide camel's-hair brush (care being taken to use paper that is not thin or unsized); after it becomes dry it is fit for use, being rendered exceedingly adhesive by a slight wetting.

—C. A. Starke, Görlitz, Prussia, has just published, says *The Publishers' Weekly*, the first number of *Ex-libris*, a journal devoted to the interests of collectors of book-plates in particular and to bookish matters in general, to be issued as often as the material in hand warrants making up a number. The first issue is almost entirely devoted to the subject-matter which gives the journal its title. It is a small quarto and handsomely printed.

—To extract grease spots from books or paper, gently warm the greased or spotted parts of the book or paper and then press upon it pieces of blotting-paper, one after another, so as to absorb as much of the grease as possible. Have ready some fine, clear essential oil of turpentine, heated almost to a boiling state; warm the greased leaf a little, and then with a soft, clean brush wet the heated turpentine both sides of the spotted part. By repeating this application the grease will be extracted, according to *The Publishers' Weekly*. Lastly, with another brush dipped in rectified spirits of wine, go over the place, and the grease will no longer appear, neither will the paper be discolored.

— D. Appleton & Co. announce "A Text-Book in Psychology," translated from the German of Johann F. Herbart. The central idea of the author's "attempt to found the science of psychology on experience, metaphysics, and mathematics," is *apperception* — recognition and comparison of features of an object with which we are familiar — in contradistinction to *perception*, in which an object is merely presented to our senses. The book makes the eighteenth volume in the International Education Series.

— A. C. Armstrong & Son, in conjunction with Elliott Stock, London, will publish the Camden Library, a series of volumes "concerned with the antiquities of Great Britain," and edited by G. Laurence Gomme and T. Fairman Ordish. The first volume, just ready, deals with the "Antiquities and Curiosities of the Exchequer," containing numerous illustrations from original MSS. and the various records preserved in the Public Record Office. Antiquities of the stage will be looked after in "Old London Theatres," and yet other volumes will be entitled "English Homes in the Past," "Monastic Arrangement," "English Armor," "Folk-Lore," "Church Plate," "The Streams of London," "Miniature Portrait Painting," etc.

— "Papers in Penology, second series," is a little pamphlet compiled by an inmate of the New York State Reformatory, and printed and stitched by other inmates of the same institution. It contains papers from various authors on the subject of prison reform, most of which have been published in some form before. It opens with three articles on the prisons of Great Britain, originally contributed to the New York *Times*, by Jay. S. Butler; and these are, perhaps, the most interesting in the whole collection. The other papers are on various aspects of the prison reform question, and written by Charles A. Collin, William T. Harris, Hamilton D. Wey, and Eugene Smith; while the last one of all is an account of "the Elmira Reformatory of To-day," by the editor of the pamphlet. This last is somewhat marred by a peculiar and rather grandiloquent style, but otherwise it is an excellent description of the reformatory methods now practised under the prison laws of the State of New York. Some of the writers carry their zeal for prison reform to an extravagant degree, and Mr. Collins in particular actually says in his last sentence that "the object of criminal punishment is the improvement of the offender." On the whole, however, the views here presented are sensible, and persons interested in the subject will like to possess the pamphlet.

— Harper & Brothers have just published "Pharaohs, Fellahs, and Explorers," by Amelia B. Edwards; and "Sharp Eyes, a Rambler's Calendar of Fifty-two Weeks among Insects, Birds, and Flowers," written and illustrated by W. Hamilton Gibson.

— Mr. J. H. T. McPherson has prepared a brief "History of Liberia," which will doubtless be of interest to students of the

Publications received at Editor's Office, Nov. 4-17.

BALL, R. S. Starland. Boston, Ginn. 376 p. 12°. $1.10.
PAPERS in Penology. Elmira, N. Y., State Reformatory. 148 p. 16°.
PICK, E. Pick's Method applied to Acquiring the French Language. Syracuse, N. Y., Bardeen. 113 p. 12°. $1.
POOLE, J. The Practical Telephone Handbook. New York, Macmillan. 282 p. 12°. 75 cents.
POPE, F. L. Modern Practice of the Electric Telegraph. (14th ed.) New York, Van Nostrand. 234 p. 8°. $1.50.
REMONDINO, P. C. History of Circumcision from the Earliest Times to the Present. Philadelphia, Davis. 346 p. 12°. $1.25.

CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

Nov. 7.—E. M. Gallaudet, Values in the Education of the Deaf; J. C. Gordon, The New Departure at Kendall Green.

Chemical Society of Washington.

Nov. 12.—W. H. Krug, Estimation of Iron, Alumina, and Phosphoric Acid; H. W. Wiley and W. H. Krug, The Occurrence of Artificial Crystals of Calcium Phosphate; H. W. Wiley and W. H. Krug, A New Butter Adulterant; Cabel Whitehead, The Uses of Cadmium in Assaying Gold Bullion.

Biological Society, Washington.

Nov. 14.—T. S. Palmer, Winter Aspects of the Mojave Desert Region; V. A. Moore, A Case of Echinococcus in Swine; C. W. Stiles, Notes on Parasites: — Coccidium bigeminum Stiles; L. F. Ward, Haeckel's Radiolaria of the Challenger Expedition; L. F. Ward, Three Days in the Tropics.

Engineer's Club of Philadelphia.

Oct. 17.—B. E. Fernow, Tests of Timber now being made under the auspices of the Agricultural Department; F. H. Lewis, Soft Steel in Bridges.

Boston Society of Natural History.

Nov. 4.—G. L. Goodale, The Natury History Museums of Australasia; Warren Upham, Recent Fossils of the Harbor and Back Bay, Boston.

Nov. 18.—George Baur, A Visit to the Galapagos Islands; W. M. Davis, The Catskill Delta in the Post-Glacial Hudson Estuary.

Appalachian Mountain Club, Boston.

Nov. 11.—J. B. Harrison, Open Spaces for Public Resort.

negro problem. It opens with an account of the earliest and unsuccessful attempts to plant a negro colony in Africa, and then proceeds to trace the leading events in the history of Liberia from its foundation to the present time. The difficulties and distresses of the past few years having been surmounted, the colonists have had considerable time to show what they are capable of and what may be expected of them in the way of government and civilization; but, unfortunately, their record is not so good as might be wished. Mr. McPherson defends them as well as he can, but he is obliged to admit that they have incurred a public debt, the interest of which they are unable to pay, and for which they have nothing whatever to show. Moreover, their presence in Africa has not as yet had any practical influence in civilizing the natives; and all attempts to propagate Christianity among the native tribes have proved unavailing, while Mohammedanism is spreading among the same tribes with great rapidity. On the whole, it would be neither surprising nor regrettable if, as Mr. McPherson fears, the little republic should eventually be brought under the sovereignty of Great Britain. Mr. McPherson's pamphlet is published by the Johns Hopkins Press, at fifty cents.

— It is not, says *Iron*, generally known that the light of the sun and the moon exercises a deleterious effect on edge tools. Knives, drills, scythes, and sickles assume a blue color if they are exposed for some time to the light and heat of the sun; the sharp edge disappears, and the tool is rendered absolutely useless until it is retempered. A similarly prejudicial effect has been exercised by moonlight.

— Steps have been taken, we learn from *The Publisher's Weekly*, to establish an "Authors' Museum" in St. Petersburg, to contain mementos and relics of famous Russian literary men and women. It is probable that the Puschkin Museum in the Lyceum, and the Sermontoff Museum in the Nikolai Cavalry School, will be incorporated in the new institution, if completed.

SCIENCE

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QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

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N. D. C. HODGES,
874 BROADWAY, NEW YORK.

SCIENCE

NEW YORK, NOVEMBER 27, 1891.

HIGHER EDUCATION OF WOMEN.[1]

I HAVE often expressed surprise, and sometimes indignation, that citizens of a State which possesses two great universities — Columbia and Cornell — should so often decide to send their children to the universities of other States — to Harvard, or Yale, or Princeton. Apart from special preferences or personal associations with one or the other university, the parent often claims that absence from home is essential to the complete education of a boy. This proposition is, I think, open to much dispute. But it becomes still more assailable when applied to the education of girls.

It seems to me that the origin of this idea, as of so many others that claim a logical basis, is really an historical tradition, derived from conditions of life in England, where the youth to be educated were chiefly recruited from families scattered through the country, and who must therefore necessarily leave home in order to acquire a university training. In England also originated the idea that to "make a man of a boy," he must be thrown young into the often brutal public life of the great public schools, and in tender years be consigned to a rough-and tumble existence, because in mature life this was what he would be expected to lead.

The feminine counterpart to the boys' public school was the young ladies' boarding-school. Here the girl was expected to acquire manners and finish, as there the boy was expected to learn manliness. Intellectual considerations had little to do with the choice in either case.

If we throw aside the subtle influence of tradition, and state clearly the reasons which should incline parents to send their daughters away from home to be educated, it is easier to note where these reasons may still hold in modern times and where they have become invalid.

Evidently, to share the privileges of a university, it is necessary to be a resident of a university town, so that non-residence in such a town becomes an imperative reason in favor of sending girls away from home, if it be once decided that they are to have this training. Again, if a family is consciously and avowedly on a lower plane of intelligence, education, or refinement than that to which it is desired that the daughters shall attain, it may again be necessary to remove the latter entirely into a different sphere of life and thought, while their minds and characters are being moulded.

Or, again, it may be desired to educate girls rather against their will, as is so often the case with boys, and therefore considered best to remove them into a special atmosphere, where they shall be uninfluenced by family or social distinctions, where, as the phrase is, "they shall have more systematic training." This might happen for younger girls, whose older sisters were going out into society.

Admitting that these considerations may all become imperative in certain cases, it remains true, however, that they must always be enforced against counter considerations of such strength as often justly lead parents to forego a college education for their girls altogether, rather than incur the risks of sending them away from home.

Whatever may be the use or abuse of a gregarious life for boys and young men, there can be no doubt that it involves great risks for adolescent girls. All the voluminous literature that has been written on the dangers of "coeducation" for girls really applies to gregarious education with members of their own sex. A girl thrown into a mass of several hundred other students, is subjected to a constant nervous strain, which, indeed, may be borne by the robust and healthy, but to which the nervous and delicate too often succumb. The physical evil of such massive association is beginning to be recognized, and combated by the device of substituting smaller groups of students in isolated homes or cottages, for the vast dormitories of the earlier colleges, which resembled magnified models of the old-fashioned boarding-schools. Still it remains true that a girl placed in an army of her fellows is in a position peculiarly foreign to her nature, which demands — possibly merely from the influence of immemorial inheritance and tradition — an individual setting, a family life. "It is natural," Goethe says somewhere, "for boys to wear uniforms: it is equally unnatural for girls to do so, for they are not destined to live or act in masses, but each is to be the centre of a home."

Thus a girl who is living at home, or who, in default of that, is living in a private family while attending lectures at a university, is running counter to no traditional organic habits of sex, whether her fellow-students be all girls, or whether the classes be mixed. But if she be removed to an institution, she is placed to that extent in the unfavorable conditions common to the monastery, the nunnery, and the orphan asylum. These unfavorable influences may, of course, be resisted, and are so in many cases, but they are always theoretically unfavorable, and not favorable, as is often claimed; and on that account certainly should not be encountered except under pressure of absolute necessity.

"The systematic training," which consists in shutting up a girl exclusively in one set of ideas, horizons, and pursuits for three or four years, is again a disadvantage and not an advantage. The great thing that youth requires, and that female youth requires especially, is change, change of thought, scene, interest, frequent and absolute relaxation of tension. It is perfectly understood that in boys' colleges this imperative need of complete change is apt to be met, not only by innocent though boisterous recreation, but often also by far from innocent dissipation. A young man has been expected to "sow his wild oats" at college coincidently with the seed from which he hopes to reap a satisfactory harvest. But girls are too docile, too unenterprising, for these violent reactions. They have less innate force of reaction, and thus a greater tendency to adjust themselves to the exact temperature of their surroundings. It is desirable, therefore, that their surroundings should not be of a uniform character, but rather varied, accidents, such indeed as are offered by the daily incidents of family life.

The intellectual life of the university should, wherever practicable, be blended with this family life. When it is shut off from the latter, the four college years are dropped

[1] Dr. Mary Putnam-Jacobi, in the Evening Post.

like a solid isolated block into the life of the girl — we might say like a meteorite fallen from the sky. It is often felt that, when these college years are finished, everything connected with them is to come to an end, be set aside, the student herself is regarded as a finished product, turned off from a mysterious machine, to be henceforth separated from it as distinctly as a box from a turning-lathe.

All this habit of mind is again characteristically English — true English Philistinism, which is frankly indifferent to intellectual interest for its own sake — but accepts a prescribed intellectual drill as a means of attaining — it is not clearly apprehended what.

Removal of a girl from her mother's care, during the critical years of adolescence, must always be an evil morally and physically, even when it is an advantage intellectually. That is to say, it must be an evil, whenever the mother is adequate to her charge, which, of course, is only too often not the case. The girls are the exception whose health does not require constant and careful supervision, and it is absurd to expect such supervision from the girls themselves. A young person is a prig, who is competent, unadvised, to look after her own health. It is perfectly true that thousands of mothers prove themselves even more incompetent, either through indolence, or ignorance, or indifference. But, theoretically, we expect a mother to be watchful, well informed, far-sighted, and intensely solicitous. Such an anxious mother, if nervous, uneducated, and weak, may, indeed, do as much harm to the girl by over-fussing and spoiling as can the mother who is indifferent to the plainest laws of health; and the girl will do better, if removed to the impartial jurisdiction of a college faculty. But this is not then a change from good to better, but from worse to good by default.

The foregoing remarks have been suggested by surprise at the fact that relatively so few citizens of New York seem as yet to have become aware of the great advantage that has been brought to their doors by the foundation of the Barnard College for women in connection with Columbia University. Nearly half of the pupils thus far enrolled are not from New York City, but from without our gates,[1] and at the same time New York girls leave their homes every year for the colleges of other States — where they can only study under the disadvantages which have just been enumerated. Nay, more, these disadvantages are not counted as such, but on the contrary are reckoned as so many reasons for preferring the exile from home. For a quarter of a century the anomaly has existed that daughters of the wealthiest or the most highly educated citizens of the great city of New York have been deprived, except through such exile, of the educational advantages which were accessible to the inhabitants of a country town like Poughkeepsie. The parents must deprive themselves of the delight of a daughter's society during four of the most charming years of her life; or else deprive the girl of the "still air of those delightful studies" which should throw a charm over all her future life and lend a force to all her faculties. During four years all the marvellous development of thought and feeling which goes to the making of character, all the delicate details which go to the formation of manners, must proceed unwatched by the eyes that have the most intense interest in both, or else the babyish system of education must be continued, which arrests the intellectual training of a girl at the very point where, for a boy, it first begins to be strenuous. This injurious anomaly in our social structure was removed, or rather the first step was taken to remove it, when, in a measure, Columbia College opened its doors to women. Compared with what should be necessary when the girls of New York shall have come forward in proportionate numbers to claim the privileges of their university, the measure is slight and the beginning small. From this small beginning, however, a full university education for women cannot fail to grow so soon as the citizens of New York thoroughly appreciate, not only the value of such education, but the value of having its facilities at home, brought to their doors, when they realize that their girls may now claim their share in the intellectual inheritance of the race, without incurring the risks of expatriation from home which were already inherent in the boarding-schools of the sampler and crochet-needle, but are now too often laid to the account of a little Latin and less Greek.

[1] The Free Competitive Scholarship for the best entrance examination into the Freshman Class for the year 1890–91 was won by a graduate of the Jersey City High School.

CAN WE MAKE IT RAIN?[1]

THE recent experiments in rain making in Texas, under direction of General Dyrenforth, and which have attracted the attention of the whole country, seem attended by a certain amount of success.

General Dyrenforth has proceeded upon the theory that heavy concussions in the upper air currents would cause a disturbance of these currents and thus produce rain. Consequently all his attempts have been to produce the greatest possible noise in the endeavor to cause a commingling of currents proper for a condensation of their moisture.

Every scientist knows, and a moment's thought ought to convince any one, that concussions cannot cause rain-fall. An explosion in the air is immediate in its effects. It becomes in fact merely the propagation of a sound-wave, which, travelling about eleven hundred feet in a second, has but an instantaneous action upon the air through which it passes, and in which it is gradually frittered away into heat. In a small part of a second the air is again the same in temperature and density. The greatest effect, then — the practical effect — must follow close upon the concussion. Therefore, if General Dyrenforth's tremendous explosions, his "air quakes," produced rain-falls in Texas, there should have been an immediate down-pour in that particular locality as a result of each explosion. But such was not the case. In every case, according to his statements, the rain has fallen from two to twenty-four hours after the explosions, and over extended areas. In a few instances, when rain-clouds were already present, General Dyrenforth says *drops* of rain fell within a few seconds after the explosions. The violent concussions may have had to do with the formation of these drops, but the true and only valuable rains came hours after every possible effect of the concussion had gone.

It is an observed fact that rains have followed the heavy cannonading of battles. But these rains did not fall until several hours after the concussions of the air had completely ceased. So, too, the proverbial showers of the Fourth of July come late in the afternoon or during the day following.

Further, it is noticeable that during a thunder-storm a lightning-flash and its attendant thunder are usually accompanied by a sudden increase of rain downpour. This has been frequently attributed to the discharge of electricity in the clouds. But the increase and the flash occur so nearly simultaneously, that the rain-drops must have started from

[1] Since the above was presented before the University Science Club, on Nov. 13, I have read with interest Mr. T. G. McPherson's excellent presentation of Aitken's experiments on "Dust," in the Popular Science Monthly, December, 1891.

the clouds above, before the flash. Otherwise they could not have reached the earth at so nearly the same time. In fact, Professors Ayrton and Perry show (*Phil. Mag.*, 1878, v., 197) that condensation is a cause for increase of electrical potential, and this may produce the flash, and not the flash the condensation.

If, then, the lightning is the source of the sudden and increased downrush of rain, in thunder-storms the same evidence precludes the thunder also as a cause. If General Dyrenforth's heavy cannonading and concussions could evoke the rain-drops, then much more should we expect the increase with the terrific reverberations of the thunder. But all the proof is against his sound theory. The heavy detonations, then, upon which General Dyrenforth bases his theory are unnecessary, and the success of his experimenting must be looked for in causes other than the noises of the explosion.

One turns naturally, then, to the products of the explosives. In General Dyrenforth's experiments, minute solid particles of silica and carbon were liberated as results of the explosions of the dynamite and rackarock. This fine dust, entering into the upper air-layers, might have served as nuclei about which the moisture could gradually condense to finally form rain-drops. When this has been accomplished the rain fell, and not before. Even where the immense oxy-hydrogen balloons were exploded, the dynamite batteries were for hours steadily throwing fine powders of silica and carbon into the air.

Now it is well known that hail-stones, which are products of the vapor condensation, often show a nucleus of a particle of dust, and in volcanic regions frequently of a granule of ashes. In these cases a dust-particle was the centre of the condensation. This fact furnishes strong evidence to support the theory, that very small particles of dust may form the nuclei of the rain-drops and that the sudden presence of fine powder in the upper strata of air will lead to condensation if sufficient moisture be present.

It is well known that during the first few strokes of an air-pump, a vaporous cloud appears in the receiver. Some ten years ago Mr. John Aitken, in studying the London fogs, proved that if the air in the receiver be first filtered through cotton-wool so as to be dust-free, then no vapor cloud appeared (Nature, Dec. 30, 1880, 195). He came to the conclusion, and stated it clearly, that no condensation will take place unless some solid nucleus as dust be present.

The writer has recently performed some laboratory experiments similar to those of Aitken, to seek corroboration of his results, and to determine any relative difference in the properties of different dusts as regards their power for condensing moisture. I find with Aitken that condensation under the receiver of the air-pump does not take place in dust-free air, and, further, that, with different powders introduced, the amount of apparent condensation varied. The experiments were then repeated without the air-pump as follows: Into a large glass sphere filtered air was introduced, and then a steam jet discharged into it. No trace of condensation was present. Then air containing products of sulphur combustion was put in, and a heavy condensation became visible. In a similar way, vapor clouds appeared with ordinary atmospheric air and with air containing gun-powder smoke.

In this way it was found that such powders as carbon, silica, sulphur, and common salt are particularly capable of precipitating the moisture, while the burning of sulphur or gunpowder gave heavy visible clouds of vapor.

Laboratory experiments cannot represent conditions which hold on a larger scale in Nature. Still they may be suggestive. So from these experiments it may be legitimate to reason that the finest dust introduced artificially into the higher regions of the atmosphere will furnish centres for condensation, and by gradual agglomeration of moisture induce a rain-fall. It must, however, be borne in mind, that there must be sufficient water vapor in the atmosphere above to gradually collect upon the dust. Therefore not under every atmospheric condition could a rain-fall be hoped for.

To prove and to make practical use of this dust theory, elaborate and expensive experiments would not be necessary. In place of the costly outfit required by General Dyrenforth for producing his terrific noises, upon which his sound theory depends; in place of the heavy mortars transported to the plains; in place of the immense retorts with acids and chemicals for producing oxygen and hydrogen gases necessary for his balloons, there could be substituted the relatively inexpensive fire balloons. By sending up a few of these there could be carried aloft a mile or so apart a quantity of impalpable powders. Then at the heighth of about a mile any feasible means of scattering this powder into the air might furnish the occasion for an artificial rain-fall. The burning of sulphur or gun-powder by fuses timed for the proper height of the balloons should also be tried.

It might be urged against this theory, that many instances may be cited where dust has been superabundant even in the upper air layers, and no increase of rain-fall noticed; that volcanic eruptions emit quantities of finest ashes to the atmosphere above, as did Krakatoa a few years ago, whose dusty breath circled the earth for many a month, and yet no unusual aqueous precipitations were observed. But it is to be remembered that if the number of the dust particles is excessive, the amount of moisture in the air, which is always limited, will be divided among so many that the agglomeration upon each will not be sufficient to cause it to fall as rain-drops.

If this dust theory be true, the amount of powder borne aloft and exploded from the balloons need not be beyond the limits of practicable experimenting. At least the experiments necessary to test the theory would be incomparably cheaper than General Dyrenforth's, and, if successful, artificial rains could be ordered at a cost which General Dyrenforth's explosive bombardments cannot approximate.

LUCIEN I. BLAKE.
Department of Physics and Electrical Engineering, State University of Kansas.

NOTES AND NEWS.

DR. A. H. BEALS has been appointed professor of pedagogics and natural science, Georgia Normal and Industrial College, Milledgeville, Ga.

—At the sixty-fourth meeting of German naturalists and physicians at Halle, on the 22d of September, Dr. Below gave an important address on "Health in the Tropics." He came to the conclusion that the opening up of the tropics for Europeans was practically a question of hygiene, and that, with proper sanitary precautions, the most apparently unhealthy districts may be rendered salubrious.

—At the recent meeting of the Italian Congress of Internal Medicine initial arrangements were made for the next International Medical Congress, which is to meet in Rome in 1893. In what month of the year it will be held is an important question not yet decided, according to *The Lancet*. At midsummer, or in the early autumn, Rome is not likely to be found attractive to those who dread subtropical heat in a malarious vicinity. If held in the spring, or the late autumn, many teachers of medicine will not be able to attend. The last fortnight of September is what the majority of Italian practitioners would suggest as the most convenient time for all parties, and this will most probably be the decision of the Organizing Committee. Meanwhile, that committee has just been formed. Dr. Baccelli, at a meeting of the heads of the profession, was nominated president by acclamation. On his declining the honor, the question was put to the vote, when, out of a ballot of twenty-six, he obtained twenty-five "si," as against one "no," which was himself. He had, therefore, to bow to the overwhelming importunity of his colleagues. The post of general secretary fell, almost unanimously, to Professor Maragliano of Genoa. Presidents of the various sections were next elected. These sections are twelve in number, and, as the results of the various ballots, the following gentlemen were appointed: anatomy, Professor Antonelli; physiology, Professors Albini and Albertoni; pathology, Professors Bizzozero and Foà; pharmacology, Professor Cervello; clinical medicine, Professors Baccelli, Maragliano, Murri, and Bozzolo; surgery, Professor Bottini; obstetrics, Professor Morisani; psychiatry, Professors Morselli and Tamburini; ophthalmology, Professors Devincenzi and Secondi; dermo-syphilopathy, Professors Campana and Barduzzi; forensic medicine, Professor Tamapia; hygiene, Professors Pagliani, Celli, and Canalis. The importance attached to this great medical parliament is already apparent in the number of physicians and surgeons who have intimated their intention to assist.

— The Volcano Islands have been annexed by Japan. The group lies 135 miles to the south-east (south-west?) of the Bonins and about 1,700 miles from Yokohama. It consists of Sulphur Island, situated in 24° 46′ north latitude, and 141° 19′ east longitude; St. Alexander, 40 miles to the north of Sulphur Island; and St. August, at the same distance to the south. The area of the middle island, which is the largest of the three, is only five square miles. The only natural product of any importance is sulphur, which is found in a very pure state ready for shipment. The natives of the Bonins also visit these islands for the sake of the fishing.

— An extended tour of a representative of Tiffany & Co., New York, during the past summer, through Ireland, England, France, Germany, Austro Hungary, Bohemia, Russia in Europe, and Asia, where he visited all the cutting centres where stones are mined, the collections and museums, enables them to show a finer collection of gems, precious and semi-precious stones, and art objects in stone, jade, crystal, etc., than has ever been brought together at one time in this country. Notable, from the Ural Mountains, is a collection of Alexandrites, topazes of blue, green, and sherry colors, demantoids or green garnets, royal purple amethysts, changing color by artificial light, the finest and largest that have been seen in modern times; from the Ural gold washings, sapphires; pale, yellow, and blue rubies; beryls of golden yellow and green, of which two are the finest that have come from Russia in the last decade; and lapidary work peculiar to the Urals, in rock crystal, garnet, amethyst, topaz, sard, jade, and rhodonite; from the Hungarian opal mines, the finest specimen of noble opal that has been obtained for many years; from France, lapidary work equal to that famous in the periods of Louis XIV., XV., and XVI.; from Italy, Bosnia, Greece, Bactria, Assyria, and Egypt, antique intagli, stone scarabie and cylinders, incised sard cornelian, chalcedony, plasma, sardonyx, essonite, hematite, etc., some dating as early as the fifth century B.C.; from Ireland, Mourne Mountain, deep blue aqua-marines, and one very fine amethyst.

— A bulletin has been issued by the Bureau of Education, Washington, for the purpose of giving information respecting the appointment of a chief of the Department of Liberal Arts, known as Department L, and respecting the organization for holding educational congresses in connection with the World's Columbian Exposition of 1893. Since Bulletin No. 3 was issued Dr. Selim H. Peabody of Illinois has been appointed chief of the Department of Liberal Arts. Dr. Peabody was for many years the president of the University of Illinois, at Champaign, Ill. The World's Congress Auxiliary of the World's Columbian Exposition is a body authorized and supported by the exposition. It has been organized to provide for the holding of such congresses in connection with the Columbian Exposition in 1893 as will best show the intellectual and moral progress of the world. The intention is to provide proper committees to secure the attendance of leaders in all branches of human knowledge, to provide convenient meeting places, to arrange and superintend the meetings, and to publish the proceedings of all the congresses. The organization is composed in the first place of two branches, the men's and the women's, and each of these is again subdivided into two classes, resident and non-resident. The resident class of each branch is the part from which the members of committees are to be chosen. Certain non-resident persons who may be especially invited to co-operate with local committees are to be made members of advisory councils of departments, divisions, chapters, or sections, and they are expected to aid the local committees by corresponding freely and by personal conference as opportunity may offer. Other eminent non-resident persons are to be known as general, honorary, and corresponding members of the auxiliary. The general officers of the auxiliary are Charles C. Bonney, president; Thomas B. Bryan, vice-president; Lyman J. Gage, treasurer; and Benjamin Butterworth, secretary. The address is Rand Building, Chicago, Ill. Congresses are proposed for each one of the six months that the exposition is to be open. Those proposed for July are science, philosophy, invention, and education, including congresses of colleges, universities, teachers, superintendents of schools, astronomers, archæologists, botanists, chemists, electricians, geologists, ethnologists, geographers, mineralogists, metallurgists, zoologists, etc. The arrangement for the educational congress has been entrusted to a committee appointed for the purpose by the National Educational Association. Now that a chief of the Department of Liberal Arts has been appointed, the Commissioner of Education calls the attention of all educational exhibitors to the fact that the Bureau of Education has a position quite similar to their own, and can not be expected to give any information regarding the plans and scope of the educational exhibit, excepting in so far as it may be requested to do so by Dr. Peabody. All such information should be obtained directly from Dr. Selim H. Peabody, whose address is Rand Building, Chicago. The Commissioner of Education is desirous of aiding in the preparation of this work in any way that does not conflict with the authority of the regularly appointed officers of the World's Columbian Exposition.

— The King of the Belgians has offered a prize of 25,000 francs (£1,000) to be awarded in 1897 for the work giving the most satisfactory replies to the following questions: Describe, from the sanitary point of view, the meteorological, hydrological, and geological conditions of the territories of Equatorial Africa. Deduce from the present state of our knowledge concerning these matters the hygienic principles suitable for these regions, and lay down, with observations in support of the conclusions arrived at, the best scheme of life, diet, and work, as well as the system of clothing and form of dwelling best adapted for the preservation of health and vigor. Describe the symptomatology, etiology, and pathology of the diseases which characterize the regions of equatorial Africa, and indicate the treatment, both prophylactic and therapeutic. Define the principles to be followed in the choice and use of medicaments and in the establishment of hospitals and sanatoria. In their scientific researches, as well as in their practical conclusions, competitors should particularly take into account the conditions of existence of Europeans in the different parts of the Congo basin. The prize is open to foreigners as well as to Belgian subjects. Competitors must send in their works to the Minister of the Interior and of Public Instruction at Brussels before Jan. 1, 1897.

— The World's Fair Archæological survey, under the field assistants, Warren K. Moorehead and Dr. H. G. Cresson, located at Anderson Station, Ross County, Ohio, made a remarkable discovery upon Mr. C. Hopewell's farm, Nov. 14. The tumulus examined is 500 feet long, 200 feet wide, and 28 feet high. It lies in the centre of a group of twenty-six mounds, all of which were opened in September and October with good results. On account of its great size the mound was divided into five sections of forty feet each for convenience in excavating. In the first cut made in the east end nothing was found. Near the surface of the second cut two bowlder outlines resembling panthers were uncovered and measured. Like the effigy mounds in Wisconsin, they were 85 to 90 feet long, being composed of one thickness of stone. The heads, limbs, and tails were distinctly outlined. Near the bottom of the second cut were three skeletons, with objects of copper, bone, and shell. North of this deposit lay the great medicine man, or chief of the village which had erected the mound. If the number of implements is evidence of the esteem in which a prehistoric man was held by his people, he was certainly the most important Caique of the Scioto Valley. At his head were imitation elk-horns, neatly made of wood and covered with sheet copper, rolled into cylindrical form over the prongs. The antlers were twenty-two inches high and nineteen inches broad at the top. They fitted into a crown of copper, bent to fit the head from occipital to upper jaw. Copper plates were upon the breast and stomach; also on the back. The copper preserved the bones and a few of the sinews. It also preserved traces of cloth similar to coffee sacking in texture, interwoven among the threads of which were nine hundred beautiful pearl beads, bear teeth split and cut, hundreds of other beads of both pearl and shell. Copper spool-shaped objects and other implements covered the remains. A pipe of granite and a spear-head of agate were near the right shoulder. The pipe was of very fine workmanship, and highly polished. The mound is still in process of examination, two months being yet required to open it thoroughly. It is thought to indicate connection with the Aztec people, as such head-dresses are only found in Mexico and Yucatan.

— Since Laveran discovered a parasite in the blood of several patients suffering from malarial fever ten or twelve years ago, many other observations on this interesting subject have been made both by himself and by many other writers, Continental, American, and Indian. One of the latest papers on the subject is a dissertation by Dr. Romanovski of St. Petersburg, reported in *The Lancet.* He thinks that the malarial parasites are so inseparably associated with the disease that the blood of patients supposed to be suffering from malaria ought to be examined as a matter of routine, as the sputum of phthisical patients is, for microbes. He finds that the amœboid parasite of tertian fever has a nucleus which acts by means of a fibrous metamorphosis of the chromatin net-work, and not by a direct method. When quinine is administered in sufficient doses it causes the destruction of the amœboid parasite, the degeneration, which is easily observed, chiefly affecting the nucleus. With regard to the prescription of quinine, he says that it should be given in two doses of about fifteen grains each during the twelve hours immediately preceding the attack, because during that period the number of adult parasites is at its maximum. From some observations made with tincture of sunflower Dr. Romanovski was led to the conclusion that this drug, though not without its influence on malarial fever, cannot be considered as a satisfactory substitute for quinine. He appends to his work references to more than 120 articles bearing on the subject, some few of which are in Russian, but the great bulk are in more accessible languages.

— The fame of the Cape as a health resort is not of recent growth, says *The Lancet.* In the old days of our Indian Empire, long before the Suez Canal was projected, and when connection with the East was maintained exclusively by sailing ships around the Cape of Good Hope, Cape Colony was the favorite recruiting ground for our countrymen exhausted by the toils or climate of Hindustan. The Suez Canal and steam have altered all this, and the Cape has suffered in consequence. It is once more becoming known as a health resort, in consequence of that widespread movement of travel which is now making all parts of the world familiar, and turning their special features to advantage not only for commerce and adventure, but for health. The broad features of the Cape climate are as follows. Great dryness, clearness, and rarefaction of the atmosphere; abundance of sunlight; considerable maxima of heat, which are nevertheless free from depressing effects and consistent with vigor and activity; cool nights, a considerable proportion of wind; a long summer and winter, with a correspondingly short spring and autumn; much dryness of soil and scantiness of forest and vegetation. The health record is, on the whole, good. There is no yellow fever or cholera. Pulmonary affections are alleged to be relatively somewhat infrequent. Hydatids, so frequent in Australia, are rare. Rheumatism and neuralgia are frequent. Speaking generally, accommodation and means of communication are bad, but appear to be undergoing a steady change for the better.

— The *Lancet*, in describing a military bicycling trip in which the party made one hundred miles in about ten hours, says in conclusion: The most interesting part of the narrative has still to be told. The veteran cyclist, Major Knox Holmes, at the near close of his eighty-third year, mounted on a tandem with Mr. Males, a young rider under eighteen years of age, accompanied the corps, and arrived at the termination of the expedition five minutes in advance of the rest. He was a little distressed on dismounting, from too hard riding the last few miles, but he soon threw off his fatigue and joined his companions at dinner with thorough zest. His condition is physiologically peculiar. In twelve weeks' new training he has, in the most striking manner, "developed muscle" in the external and the internal vasti, the rectus, and the muscles which form the calf of the leg. It has become so entirely a part of physiological doctrine that after threescore years and ten there is no new development of muscle, that if we had not seen with our own eyes, as we have, this actual development in one whose age exceeds by thirteen years the traditional span of human life, we should have doubted the possibility of its occurrence.

— An official report by Mr. Hughes of the Geological Survey of India, on tin-mining in the Mergui district of Burmah, contains a description by Mr. Adam of a remarkable tin deposit discovered in the Maliwun district. After tracing a reef which attracted his attention from hill to hill, and taking specimens in various places and in a variety of ways, these gave such extraordinary results "that I felt myself quite puzzled to account for the enormous masses of wealth lying unheeded, more especially as many years before a European company lost all its capital within a short distance of this very place. . . . It is a most extraordinary deposit, quite beyond anything I have ever seen in my travels, nor have I heard of any miner or prospector meeting anything so rich." He then details two experiments, by one of which he got 141 pounds of ore from two cubic yards of the most unlikely rock he could see, and by the other 141 pounds of ore from one cubic yard of unselected rock. "These results," he says, "multiplied by the enormous masses of these hills, would give figures altogether fabulous in their dimensions." Mr. Hughes is not quite so enthusiastic about the discovery. He says: "I twice visited this reef, once in company with Mr. Adam and again with Dr. King, the director of our survey. There is nothing I would term a main lode, but rather a zone of metamorphic rocks through which runs of varying ore-bearing quartzes can be traced. Many of the smaller seams, of a reddish-brown color, are heavily weighted with tin ore, giving as high a proportion as 60 per cent. The primary value of the reef is dependent on the persistence of these courses of quartz; for, apart from them, little or no ore was obtainable by rough washing samples of the rock. In dealing with the claim of this reef to exceptional richness, we have to allow for the vicissitudes which seem to dog the persistance of all metalliferous indications in India, and we have to allow for the accident of the courses of quartz dying away as they descend. At first sight there is nothing to suggest such a liability, but we have, in the hi tory of unsuccessful efforts to work the lodes from 1873 to 1877, a warning as to the possibly fleeting nature of the deposit under discussion. This, however, is the very worst aspect that can be assumed. And the pleas on the other side are that the reef has been traced for more than three miles, that a large portion of it can be won by surface blasting, and that the statements made as to the precarious character of the runs of quartz are based on imperfect evidence. The point on which there can be no dispute is that there is a large mineralized zone of rock exposed in the form of a prominent, well-defined hill, which is free from any speculative doubts as to its existence. At the spot known as Khow Muang there are at least 60,000 tons of reef within sight."

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

JOHN FRANCIS WILLIAMS.

JOHN FRANCIS WILLIAMS, Ph.D., assistant professor of geology and mineralogy in Cornell University, died at Ithaca Monday evening, Nov. 9, 1891. Although Dr. Williams was only twenty-nine years of age, he had achieved eminent distinction. He took his baccalaureate degree at the Troy Polytechnic Institute, and afterward studied at Göttingen for three years with such success that when his professor, Dr. Klein, went to Berlin, Dr. Williams accompanied him as assistant. Returning to America, he was appointed curator of the mineralogical and industrial collection of the Pratt Institute of Brooklyn, L.I., which, conjointly with Professor Nason of the Rensselaer Polytechnic Institute of Troy, was formed in Europe. He then became docent in Clark University, and afterwards was employed in a very important part of the State survey of Arkansas. In the course of the survey, extending over two years, he collected minerals for a very complete report on the mineralogy and petrography of the State, a volume of some four hundred pages being now in press. Some of his work has been complimented by Dr. Rosenbusch, the greatest living authority, as among the best he had ever seen done by an American.

Dr. Williams had just entered on his work of instruction in Cornell, when it became apparent that he had brought from the malarious regions of Arkansas the seeds of a fatal disease. His instruction was highly praised by his students, and he was universally esteemed by his colleagues.

Dr. Williams was one of the best of the new school of mineralogists, being thoroughly rounded in his knowledge of the science, being an excellent chemist, crystallographer, petrologist, and geologist.

Dr. Williams was born at the old family homestead, in Salem, N.Y. He was the son of John N. Williams, and belonged to one of the oldest families in New York.

Among his published papers were "Eudialyte and Eucolite, from Magnet Cove, Arkansas," in *American Journal of Science*, December, 1890; "Manganopectolite from Magnet Cove," Zeitschrift f. Krystallographie und Mineralogie, P. Groth, Leipzig, November, 1890, pp. 386-389; "Igneous Rocks of Arkansas," Vol. II. of the Publications of the Survey, 1890; "Ueber den Monte Amiata in Toscana und Seine Gesteine" [Mit. Taf., XII.-XVI.]. Neues Jahrbuch für Mineralogie, Geologie und Paleontologie, BB. V. 381, 1886, his most important work; and a volume of some four hundred pages on the mineralogy and petrology of Arkansas, now in press.

THE COMMON EDIBLE CRAB FOUND FOSSIL IN THE HUDSON RIVER TUNNEL.

DURING work on the Hudson River tunnel, as carried on from the New Jersey side, and when at a distance of about 3,100 feet from the New Jersey opening, one of the workmen noticed a hard nodule among the silt as it was being taken out at the heading, and secured it as an object of curiosity. On being washed the nodule, which is about six and a half inches long by two and a half wide and an inch thick, was seen to contain quantities of a small sea shell (*Mactra lateralis* say) and remains of a crab.

Subsequently this nodule, which is of a hard limestone nature on the inside, although soft and muddy externally, came into the possession of William Dutcher, Esq., of this city, who presented it to the American Museum of Natural History, where it will be preserved in section 12 of case Q of the Geological Hall.

On removing some of the stone from the left side of the back, the lateral spine characteristic of our common blue or edible crab (*Cullinectes hastatus*, Fabricus; = *Lupa dicantha*, Latreille, of the New York State Natural History, Zoology, plate III., fig. 3) is shown, which proves it to be an ancient example, about two-thirds grown, of this much esteemed and highly prized frequenter of our city markets, restaurants, and hotels, as well as of many private tables, although at present by no means in the soft shell condition, for the nodule is so hard internally as to yield only to the action of a hammer and chisel; although externally looking like a nodule of hardened mud. The nodule exposes a little more than half of the upper surface of the back, and parts of each of the large claws; and in removing the stone from the surface, impressions of several leaves were exposed, and a fragment of sea grass.

The finding of this species in a fossilized condition, in the position from which it was taken, is a matter of considerable interest, as it is the only instance known of its existence in a fossil condition. It proves this animal to have inhabited the shoals and bays of this region for a period dating back to probably long before the advent of man, for its depth below the bottom of the river at that point, which is about thirty-five to forty feet to the centre of the tunnel, together with its perfectly fossilized condition, would indicate the lapse of considerable time since its entombment.

R. P. W.

ASTRONOMICAL NOTES.

ON May 22, 1886, Mr. W. R. Brooks, then living at Phelps, N.Y., discovered a telescopic comet which has been the subject of an extensive discussion by Dr. S. Oppenheim of Ottakring. He finds that the comet is a short-period one, of from 5.7 to 6.1 years. In No. 3,064 of the *Astronomische Nachrichten* Dr. Oppenheim publishes a sweeping ephemeris covering the period from Jan. 1 to Sept. 17, 1892.

Previous to his death, Professor Theo. Oppalzer had under his charge the orbit of the short-period comet discovered by

Professor Winnecke, at Bonn, on March 8, 1858. This comet was originally discovered by Pons, at Marseilles, on June 12, 1819. Since Oppalzer's death, Dr. Haerdtl of Vienna has taken up the orbit and discussed it, and also computed the perturbations the comet has experienced since last seen. The last return of the comet was in 1886, when it was discovered by Mr. Findlay, at the Cape of Good Hope, Aug. 20. At the time of discovery the comet had passed its perihelion, and was twelve days ahead of its predicted place. Its distance from the earth at the time of discovery was about one hundred and fifty million miles. In No. 3,062 of the *Astronomische Nachrichten* Dr. Haerdtl publishes an ephemeris to assist in finding the comet during its approaching return. The date of next perihelion passage is June 30, 1892. At the present time the comet is about two hundred and fifty millions of miles from the earth, and is of course beyond the reach of all but the most powerful telescopes, and probably even them. In the latter part of next January the comet should be within the reach of moderate-sized telescopes. A copy of the ephemeris will be published before that date.

The following are the positions for Wolf's comet for following dates. The epoch is for Greenwich midnight.

1891.	R. A.			Dec.	
	h.	m.	s.	°	′
Dec. 1.5	4	24	18	—13	22
3 5		23	4	13	43
5.5		21	52	14	0
7.5		20	45	14	15
9.5	4	19	42	—14	27

The eclipse of the moon on the night of the fifteenth of the present month was not generally observed at stations in the eastern portion of the United States, due to a very cloudy sky. The only satisfactory observations, as far as known, were those made at Harvard Observatory. It was cloudy at Albany, Rochester, Princeton, Washington, and the University of Virginia, points at which large telescopes are located. Professor Dölland, late of the observatory at Pulkova, Russia, had prepared a large list of stars that would be occulted during the eclipse. Preparation had been made at the several observatories mentioned to observe as many of these stars as possible, to assist in revising the present value of the semi-diameter of the moon.

FOREST AND MINERAL WEALTH OF BRAZIL.

A BULLETIN lately issued by the Bureau of the American Republics states that the inexhaustible forests of Brazil abound in woods of great value, some of the most beautiful and valuable being entirely unknown in Europe. The large collection of Brazilian woods exhibited in Philadelphia in 1876 attracted much attention, and the catalogue mentions 22,000 different woods found in the valley of the Amazon alone. The best known of the valuable woods among those of the Amazon are rosewood, satin wood, shell wood — of which latter beautiful shell-like articles are made. The cedars of Brazil are entirely different from the European, and they abound everywhere from north to south. During the floods of the Amazon, they are seen borne along by the current, as a writer on Brazil describes them, "mighty trunks of foliage like floating islands." Among the medicinal plants of the Amazon valley may be mentioned the sarsaparilla, ipecacuanha, the polycarp, the cubeb, the curare,— from which the Indians extract the poison for their arrows, — the *nux vomica*, etc. On the Atlantic coast, the variety of valuable woods is continued, and mention may be made of the acapú and angelica, and the bacury, which is the building wood most in use in Maranham.

The forests abound in plants producing textile fibres. A firm at Ceará has lately commenced the manufacture of the *gravatá* fibre, a plant belonging to the *bromeliacea*. The rubber tree exists in several varieties, producing as many different sorts of rubber, and all through the northern regions it thrives well. The once famous Brazil wood, which gave its name to the country, lost its importance with the discovery of the cheaper aniline dyes, and its exportation has dwindled to insignificance. Gutta-percha is produced in Brazil from two species of trees, the jaguá (*Lucuma gigantea*) and the massaranduba (*Mimusops elata*). The beautiful vinhatico, much employed in Brazil for furniture and cabinet work, enjoys a considerable reputation, the greater part of the furniture in Brazil being made either of rosewood or vinhatico. The beautiful shaded yellow of this latter makes it remarkable among the woods at once useful and ornamental.

The development of the vast mineral resources of Brazil, with the exception of gold and diamonds, has only just begun. Its deposits of coal and iron, laid bare by scientific explorers, await for the most part the labor and machinery necessary to utilize them. The existence in Brazil has been demonstrated of copper, manganese, and argentiferous lead ore, in considerable quantities, and in widely extended localities. There are also mines of iron, coal, gold, and diamonds. Gold is found in every State in Brazil, and is systematically mined in Minas Geraes, Rio Grande do Sul, Bahia, Matto Grosso, Parana, Sao Paulo, and Maranham.

Diamonds are co-extensive with the gold-deposits, and, like that metal, are most abundant in Minas Geraes, where they have been found since 1789. The most important locality known for the production of these gems is the district of Diamantina, in the above-named State. They are found in Parana, in the gravels of the river Tibagy, and in the bed of streams dry during the summer. Since the discovery of diamonds at the Cape of Good Hope, the Brazilian production has greatly diminished.

As regards iron, the State of Minas Geraes abounds with it. It is not found in veins or strata, buried deep in the earth, but in enormous beds, often lying at the surface, or in mountain masses. These vast deposits are worked only by small scattered furnaces, charcoal being used in the reduction of the ore. Of these small furnaces there are five groups, producing about 3,000 tons annually, the product being used in the surrounding districts in the manufacture of articles of home consumption, such as hoes, shovels, picks, drills, nails, horseshoes, etc. In the State of San Paulo are found deposits similar to the best Norwegian ore; and one of the mines is worked by the Government establishment, near the village of Sorocaba. This establishment has two furnaces, and produced in one year about 790 tons of pig iron. The ore has about 67 per cent of iron. In Santa Caterina, not far from a harbor accessible to the largest vessels, are vast deposits of hematite, containing on an average 30 per cent of manganese, and 25 to 30 per cent of iron. In the State of Goyaz, as in Minas Geraes, are found enormous masses of the ore itaberite.

The presence of copper has been demonstrated in Rio Grande do Sul, in Matto Grosso, in Minas Geraes, and Ceará. The ore has never yet been mined, but in the last named State works have been begun with a view to its extraction and reduction. The ore, as far as yet reached, yields 40 per cent of copper. The deposits of lead so far discovered are few, but its presence has been determined in Rio Grande do Sul, Sao Paulo, and Minas Geraes, generally in connection with silver — argentiferous galena — and sometimes with gold. Bismuth and antimony are found in combination with ores of other metals, but not as yet in considerable quantities.

Up to the present, the deposits of coal discovered are not, relatively, so extensive as those of iron, but its presence has been determined in Sao Paulo where the borings indicated its existence in quantities and situations that render probable a profitable extraction. In Santa Caterina, in the valley of the Tubarao, bituminous coal exists, and a concession has been granted by the Government for working the beds. The State of Rio Grande do Sul appears to be the most favored in respect to coal deposits. In the Candiota basin, veins of coal crop out, of a thickness varying from four to six feet, but the only mines worked up to the present are those of Arrois dos Ratos, which supply coal to the steamers that ply on the river and to the Government railway.

Marbles are abundant and widely distributed; they are of various colors, and resist the disintegrating influences of the climate, under conditions destructive of the marble imported from Europe. In Rio Grande do Sul and Sao Paulo are various manufactures of works of marble. Important deposits of loadstone are found in Minas Geraes. In the State of Goyaz, in the Sierra dos Cristaes (Crystal Range) are found in abundance the well-known "Brazilian pebbles," whose pure quartz is employed in the manufacture of lenses and spectacles. They are found near the surface, usually covered with a coating of iron oxide. In the calcareous caverns of the San Francisco plateau and of the river Velhas, in Minas Geraes, saltpetre has for a long time been collected. One of these grottoes, near Diamantina, furnished within a few days after its discovery forty tons of the pure crystals. Graphite is also found in considerable quantities in Minas Geraes, one of the deposits yielding 83 per cent of carbon suitable for pencils.

THE CLIMATOLOGY OF BRAZIL.

A PAMPHLET by Sr. H. Morize, entitled "Esboço de uma Climatologia do Brazil," has been issued from the Observatory of Rio Janeiro. The author divides the country into three great zones — tropical, subtropical, and temperate. The first, in which the mean temperature exceeds 77° F., embraces the northern part of Brazil, and is bounded to the south by a line running along the south side of the State of Pernambuco, across Goyaz, and somewhat to the south of Cuyabá. The second lies between the isothermals of 77° and 68°, and extends into S. Paulo and Paraná, leaving a portion of these provinces, with Sta. Catharina and Rio Grande do Sul, to form the third zone, in which the mean temperature oscillates between 68° and 59°.

The tropical zone may be again divided into three regions, the Upper Amazons, Matto Grosso and the interior of the states on the Atlantic border, and the Littoral. On the Upper Amazons there are two rainy seasons, the principal one lasting from the end of February to June, and the other from the middle of October to the beginning of January. During the intervening dry season the rivers fall sometimes as much as 46 feet. Sr. J. Pinkas found that the mean temperature was 79°, but the maximum was 103°, which is comparatively low. The heat, however, was very oppressive, owing to the excessive moisture in the air. The prevailing wind blows from the south-west, and is frequently interrupted by calms. Towards the end of the great rains the phenomenon known as *friagem* occurs, which is a sudden fall of temperature produced by an influx of cold air from the Andes. It can only take place on a calm day, and is preceded by a high temperature, an almost complete saturation of the air, and a barometric fall of about .2 inches.

In the second subdivision heavy rains occur in spring and summer, and the thermometer often rises as much as 35° in a few hours. These sudden changes are produced by the rapid alternations of north-west and south-east winds, the former warm and moist, the latter always very cold. Dr. Morsback gives the mean temperature as 79.25° F. The average rainfall is 45.9 inches, and the number of raining days 85. In this region also there is a period of *friagem*.

The third subdivision is characterized by rains in summer and autumn, and particularly during the month of April. The differences of temperature are much less than in the other subdivisions, 84° F. having been recorded at Vizeu in Pará during December, the warmest month, and 80° F. at the same hour, 9 A.M., during July, the coolest month. The mean rain-fall is about 58 inches. In the dry season the prairies are withered and scorched by the heat, and the cattle that feed on them suffer terribly. Occasionally the rains do not make their appearance at all, and then famine spreads throughout the country. This calamity has occurred six times already during the present century.

The subtropical zone closely resembles the warm regions of the south of Europe. Both the temperature and the rainfall vary considerably according to the situation. The climate of the third zone is one of the finest in the world, and therefore the States comprised in it have been almost exclusively chosen by European immigrants. The rainy season does not occur in the same months as in the other regions: rain falls chiefly in the winter and autumn. As the distance from the equator increases, the transition between the wet and dry seasons becomes less distinct. The meteorology of Sao Paulo and Rio Grande do Sul has already been noticed in the *Scottish Meteorological Journal* (vol vi., p. 332, and vol. vii., 556). Sr. Morize's paper is very useful for those who wish to study the subject minutely, for he has collected numerous records of observations from all parts of the country.

YEZO.

THE island of Yezo, or Hokkaido, has an area of about 30,500 square miles. Its population, said to have been 27,000 in 1869, was, in 1889, 254,805 (including the Kurile Islands), according to the Japanese census reports. The Government, according to the *Scottish Geographical Magazine*, is actively developing the country. It is constructing a net-work of roads by convict labor, and intends to form a new capital near the source of the river Ishikari. The plan provides for 17,472 colonists, besides 1,920 houses for Tonden-he. These latter are military colonists, each of whom receives a grant of about 8 acres of land and a house, on condition of serving in war up to the age of 40. Another town is to be founded on the Sarachi A railway from Sapporo to Mororan has been proposed, the harbor at this place being more convenient than that of Orunai, where the coal of Yezo is now shipped. The dwellings of the inhabitants are by no means adapted to the rigor of the climate: those of the military colonists are slightly superior, and consist of two apartments. Cultivation and fishing are the chief occupations. Vegetables, millet, potatoes, wheat, barley, rice, and beet-root are cultivated — the last for the making of sugar. Cattle, pigs, and other domestic animals are kept in small numbers, but little attention is bestowed upon them. The Government has set up mills and sugar and hemp factories. At present they have not been remarkably active, owing either to the deficiency of raw material, or to the absence of a demand for the finished article. Fishing is a far more important industry. The annual value of the products of the sea is about £833,000, and it is on them exclusively that the taxes are levied. Herrings, salmon, and trout are extraordinarily plentiful on the northern and western coasts of the island, and cod is caught in the deep water. The native fishermen number about 60,000, and in the season these are reinforced by hired men from the island of Nipon. There are in the whole island about 17,000 Ainos, but their number is decreasing owing to the effects of disease and, more than all, intermarriage with the Japanese. In the north-east they are still in a state of degradation, but along the shores of Volcano Bay they are beginning to occupy themselves in agriculture. They are well treated by the Government, and enjoy the same rights as Japanese. Where it is possible, their children attend the Japanese schools.

PROFESSOR PICTET'S LABORATORY AT BERLIN.[1]

IT has often been remarked that purely scientific research frequently bears fruit of practical value. A fresh illustration of this fact is afforded by the work of Professor Pictet, the eminent man of science of Geneva, who is turning to practical account the apparatus by which, in 1877, he first reduced hydrogen and oxygen to the liquid state. At Berlin, where he now resides, he has established, on the scale of a small factory, what he terms a "laboratoire à basses températures." The following account of the work carried on and the results obtained is taken from papers read by the professor before different scientific societies of Berlin.

The refrigerating machinery, driven by several powerful steam-engines, is intended to withdraw heat from the objects under observation, and to keep them at any temperature between —20° and —200° C. as long as may be required. Professor Pictet's experience has led him to the conclusion that among the refrigerating agents known, such as rarefaction of gases, dissolution of salts, evaporation of liquids, the latter is to be preferred. A long course of research has further enabled him to choose the most convenient from amongst the great number of suitable liquids. In order to avoid the great pressure required in handling the highly evaporative substances of lowest boiling-point which serve to produce extreme cold, it is necessary to divide the difference of temperature into several stages. Each stage is fitted with especial apparatus consisting of an air-pump worked by steam, which drains off the vapors of the liquid from the refrigerator, and forces them into a condenser, whence, reduced to the liquid state, they are again offered for evaporation in the refrigerator. Thus the liquid, without any loss beyond leakage, passes through a continuous circuit, and the operations can be carried on for any length of time. The liquid made use of for the first stage is the mixture of sulphurous acid and a small percentage of carbonic acid called "liquide Pictet." It is condensed at a pressure of about two atmospheres in a spiral tube merely cooled by running water. Oxide of nitrogen (laughing gas) is the liquid chosen for the second stage. Its vapors are condensed in the same way at a pressure about five or six times as great in a tube maintained at about —80° by the action of the first circuit. As medium for a third stage, in which, however, continuous circulation has not yet been attempted, atmospheric air is employed, which passes into the liquid state at a pressure of no more than about 75 atmospheres, provided the condenser is kept at —135° by the first two circuits. The evaporation of the liquefied air causes the thermometer to fall below —200°.

By this combination quite new conditions for investigating the properties of matter are realized. In various branches of science new and surprising facts have already been brought to light. Many laws and observations will have to be re-examined and altered with regard to changes at an extremely low temperature.

For instance, a remarkable difference was noted in the radiation of heat. Material considered a non-conductor of heat does not appear to affect much the passage of heat into a body cooled down to below —100°. Or, to state the fact according to Professor Pictet's view: "The slow oscillations of matter, which constitute the lowest degrees of heat, pass more readily through the obstruction of a so-called non-conductor than those corresponding to a higher temperature, just as the less intense undulations of the red light are better able to penetrate clouds of dust or vapor than those of the blue." If the natural rise of temperature in the refrigerator, starting from —135°, is noted in a tracing, and afterwards the same refrigerator carefully packed in a covering of cotton-wool of more than half a yard in thickness, and cooled down afresh, and the rise of temperature again marked, on comparing the tracings hardly any difference will be found in the two curves up to —100°, and only a very slight deviation even up to —50°. On this ground it is clear that the utmost limit of cold that can possibly be attained is not much lower than that reached in the famous experiment of liquefaction of hydrogen. The quantity of warmth which hourly floods a cylinder 1,250 millimetres high by 210 millimetres wide (the size of the refrigerator) at —80°, is no less than 600 calories, and no packing will keep it out. At a lower temperature, the radiation being even greater, the power of the machinery intended to draw off still more heat would have to be enormous. And as —273° is absolute zero, the utmost Professor Pictet judges to be attainable is about —255°.

As an example of the surprising methods which the refrigerating machine permits the investigator to employ, it may be mentioned that, in order to measure the elasticity of mercury, Professor Paalzow had the metal cast into the shape of a tuning-fork, and frozen hard enough for the purpose in view. On this occasion it appeared that quicksilver can be shown in a crystallized state, the crystals being of a beautiful fern-like appearance.

Glycerine was likewise made to crystallize; and cognac, after having been frozen, was found to possess that peculiar mellowness commonly only attained by long keeping.

But the most important application of the refrigerating machinery has been the purification of chloroform, undertaken by Professor Pictet, at the instance of Professor Liebreich of the Pharmacological Institute, Berlin. Chloroform has hitherto been considered a most unstable and easily defiled substance. The action of sunlight, the slight impurities retained from the different processes of manufacture, perhaps the mere settling down during protracted storage, have invariably resulted in a more or less marked decomposition. By the simple process of crystallization this unstableness is got rid of, and a practically unchangeable liquid is produced. The crystals begin to form at —68°, first covering the bottom of the vessel, and gradually filling it up to

[1] From Nature.

within one-fifth of the whole volume. This residue being drained off, the frozen part is allowed to melt under cover, so as to exclude the atmospheric moisture. Chloroform thus refined has, by way of testing its durability, remained exposed on the roof in a light brown bottle from November till June without the slightest sign of decomposition.

Professor Pictet has already taken steps to introduce his process into manufacture, and proposes to apply the principle to various other chemical and technical objects. Sulphurous ether, for instance, has by a similar process been produced in a hitherto unknown degree of purity. At the same time, the professor continues eagerly to pursue the various purely scientific inquiries with which he started.

R. DU BOIS-REYMOND.

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.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Dr. Hann and the Fohn.

IN the good old meteorological times — before the advent of Dr. Hann and his fatal misapplication of the mechanical theory of heat to the phenomena of the atmosphere — it was generally considered that the hot winds of Switzerland, the so-called Föhn, had their birthplace in the Desert of Sahara. The good folks thought, in their simplicity, that the warm air which suddenly came upon them must have come from a hot place. They noticed that it always came from a more or less southerly direction, and judged that the sand-dust it carried with it must have come from some sandy region. They felt the sand-dust smart in their eyes, and saw how it discolored the snow white face of the mountains; but the sand-dust did not obstruct their vision further but they could judge that the dust must have got into the air from somewhere, and so they fixed upon the Sahara as the nearest and most likely locality.

It seems, indeed, marvellous that Dr. Hann's opposing theory could have made headway against such glaring and incontestible facts, as it should be much easier to convince the world of a simple and tangible truth than to convert it to the opposite theory, which has nothing whatever of observations of natural phenomena to support it; but when I here propose to maintain the old theory, by taking away the basis of Dr. Hann's, it may not seem unbecoming in me to say a few words in apology for such seemingly reckless behavior.

It is now nearly two years ago I published, through these columns, the rudiments of a theory of the atmosphere which is more or less diametrically opposite to the prevailing ideas on the subject. Rain was supposed to be due to expansion of moist air, and I found by experiments that it must be due to compression, etc. As far as I could ascertain, meteorologists had no objection to urge against my theory, but on further investigation it became clear to me that they possessed a high-priest, or *Dalai Lama*, in Dr. Hann, without whose sanction no new theory could be seriously considered by reputable meteorologists of any standing, and as he refrained from expressing himself directly on the subject, the matter was put aside for the time being. Dr. Hann, however, gave indirectly vent to his opinion; a few weeks after the publication of my theory Dr. Hann handed in to the Vienna Academy of Science a paper wherein he held forth that the established theories on the atmosphere required considerable modifications, and the modifications he proposed were all an approach towards the views which had immediately before been set forth by the present writer. This paper caused considerable discussion, but nobody seemed to consider the high-level observations on which he proposed to base these modifications of any real value. Any further approach to my views would undoubtedly have led Dr. Hann to upset his own theory of the Föhn, — a theory which has brought its author no inconsiderable renown during the past years, — and that any man should upset his own reputation as a philosopher could hardly be expected; and there is so far nothing to be said against his silence, as all is fair in war and love, and to gain time is the great object in all cases of emergency.

There is, however, a time for every thing, and as nearly two years have elapsed since I published what, in my humble opinion, is the true theory of the atmosphere, it may be about time for me, and my duty also, to endeavor to upset the chief obstacle against its adoption, which I consider Dr. Hann's Föhn theory to be.

I take occasion from an article by Mr. Rotch, on "Mountain Meteorology," in *American Meteorological Journal* (August, 1891), wherein this staunch upholder of Dr. Hann's views has very ably tried to systematize the aspects of the prevailing meteorological theories from this particular point of view. It is always a laudable endeavor, of any author, to try systematically to combine into a collected whole the varying theories concerning any particular branch of this science, as it enables the critic to mark out the weak point. The most consistent or systematic treatise on the atmosphere as a whole, which the present writer is acquainted with, is the "Elementary Meteorology," by Mr. R. H. Scott, and the remarkable candidness of its author made it a comparatively easy task for the present writer to point out, that, according to the causes of rain given there, we should not get any rain at all if we were to believe the gentlemen who had the atmosphere "in charge," so to speak. As I on that occasion dealt extensively with the question of the effect on the humidity of the air caused by ascent or descent of the air, I may at present confine myself to discuss exclusively the question of change in temperature caused by ascent or descent.

Mr. Rotch says, on page 154: "It has been shown by Dr. Hann that the Föhn owes its extreme warmth, as well as its dryness, to the descent from the ridges on the north side of the Alps, and that it does not bring it from further south. The warmth of the Föhn is explained by the fact that a mass of air sinking into one of higher pressure is warmed at a rate of one degree for each 300 feet of descent, and a rapidly sinking stream of air, which is so quickly heated, must be relatively very dry." And a few lines above we read: "The cool night wind (from the mountains) is caused by the sinking of the cold air into the bottom lands, and is most intense in narrow valleys, where there is great difference between the temperature of the valley and the plain," and again, during Föhn the temperature "rises sometimes 60° F. above the normal."

The unbiased reader cannot help noticing the anomaly that the mere descent of air is (1) in case of Föhn accused of causing a considerable rise in the temperature above the normal, and (2) in case of the night wind an equally considerable lowering of the temperature below the normal.

This contrast becomes even more drastic when Mr. Rotch says, page 151, "Slowly descending currents of cold air fill the valleys like rivers, while the summits receive the air warmed dynamically by descending from a greater height; and it seems obvious that the author has a little private theory of his own that it makes a great difference whether the air is descending slowly or not, whereby he tries to patch over the glaring discrepancy.

We may now set to work to put these contradictory theories to their proper test, thereby confining ourselves to statements contained in the article itself. It is thus truly mentioned that the air is warmed at the rate of 1° F. for each 300 feet of descent and cooled at the rate of 1° F. for each 300 feet of ascent, but we also find mentioned another fact, equally true, that, on an average, or under normal conditions, the temperature of the atmosphere decreases at the rate of 1° F. for each 300 feet rise; and this fact throws a peculiarly instructive light on the whole subject. It shows that under normal conditions air rising to any height will during the ascent be cooled by expansion at such a rate that wherever it goes it meets with air having a temperature exactly equal to its own, and also that air descending to any level will for a similar reason meet with air having a temperature exactly equal to its own, wherever it goes. In other words, for air arriving at any particular place to have an abnormally high or low temperature it must have had an equally abnormally high or low temperature at the locality where it started from.

Thus, in case of the Föhn wind, for this air to arrive in the valley at a temperature 60° F. above the temperature normally found there, it must have been heated 60° above the temperature normally found at the summit of the mountains from where it started, and it then remains with Dr. Hann to explain how this air acquired the abnormally high temperature before it commenced to descend, and until he has done this he can have no right to claim that he has added one particle towards the explanation of the phenomena of the Föhn; and, even if he was able to get over this difficulty, it still remains for him to explain the phenomenon of the sand-dust, before it can be recognized that the birthplace of the Föhn is anywhere but in the Desert of Sahara.

The phenomenon of cool night wind from the mountain and the accompanying higher temperature on the mountains than in the valleys find a ready explanation from the same premises. During clear nights the air nearest the earth's surface gets abnormally cooled through radiation, and the radiation is more intense on the mountains than on the plains. The cool contracted air will run off the slope of the mountain and accumulate in the valleys, while its place on the mountain-side is immediately taken up by air which has not as yet been cooled down by radiation. In the valleys the temperature gets lower than on the mountains, or the plains, because the cooling effect of radiation is there acting upon air which has previously been cooled considerably down by radiation on the mountain, and it is clear that the temperature must sink lower when radiation is acting upon air already cooled down, than when the temperature of the air was higher to start with.

The present writer has, on several occasions, tried to induce so able and prolific writer as Professor Hazen to attack his views for the sake of an argument, but the professor seems to decline to enter upon a discussion with any body who does not belong to the "meteorological camp," as he calls it. Now, be it said, in all kindness, that in our advanced age every body seems to be entitled to express his opinions on any scientific subject when he feels himself convinced of having found something new which may add to the progress of science, and also be entitled to a fair hearing; but be it said, as my impression when I accidentally arrived in the meteorological camp, all the inmates seemed to have decamped previously, leaving no one behind to shake hands with me; and this I thought a little discouraging. Dr. Hann may be a most excellent director of the Hohe Warte, and it may seem not a little reckless for an outsider to attack his theories; but it should be remembered that even a blind man may sometimes find a seed, — although a civil engineer of high training may not be entirely blindfolded, — and if there be any truth in the maxim of Dr. Hann's countryman, Feuerbach, "that no philosopher ever yet occupied a professorial chair in philosophy," so it might possibly be equally true that no philosopher in meteorology ever yet sat on Hohe Warte, however great his attainments as director or weather forecaster might have been.

FRANZ A. VELSCHOW, C.E.

Brooklyn, Nov. 9.

Auroral Phenomena.

As Dr. Veeder has mentioned in his description of the aurora of Sept. 9, in *Science* for Nov. 6, some phenomena not ordinarily accompanying auroral displays that were also visible here, some notes made at the time may be of interest.

The aurora on that evening was unusually fine, probably the most brilliant observed in four years. It began about 7.40 P.M. as a faint arch five degrees above the northern horizon, which gradually became higher until a maximum height of eight degrees was reached at 8.15 P.M. Shortly before this time two smaller arches appeared beneath the principal arch, and soon afterward the ends of the three joined together, forming a serpentine band. This band at 8.20 P.M. broke up into brilliant streamers, which were constantly changing in appearance and length, alternately fading and becoming bright again.

This continued until 8.50 P.M., when the display reached its maximum brightness and the streamers their greatest length. The elevations of the ends of the streamers above the horizon were measured with a theodolite at times, the highest being at a height of 56°, though many exceeded 45°.

Between 9.15 and 9.30 P.M. the aurora diminished greatly in brightness, and at 9.25 two bands extended toward the zenith from the east and west respectively, joining together at 9.27, forming the narrow band that Dr. Veeder saw. This band was apparently of a uniform brightness, approximating that of the Milky Way, and continued, through the period of minimum brightness of the aurora, from 9.25 to 9.35 P.M. After 9.35 P.M. the aurora became brighter, and was visible at 11.40 P.M.

This band of light was seen at Nashua, N.H., and in this vicinity, while the aurora has been reported as visible at several places in Europe as well as America.

A similar band of light, extending through the zenith from opposite sides of the horizon, was observed during the aurora of May 20, 1888, which was described in *Science* by several observers during the succeeding month.

Five auroras were visible during September four of which occurred on the 7th, 8th, 9th, and 10th, respectively, — an unusually large number for such a short period of time.

S. P. FERGUSSON.

Blue Hill Observatory, Readville, Mass., Nov. 20.

AMONG THE PUBLISHERS.

D. C. HEATH & Co., Boston, will soon publish *Business Law*, prepared by Alonzo P. Weed. This is not only a text-book for business colleges and the business courses of schools and academies, but it is desirable for the desk of the business man.

— Charles F. Lummis, a Harvard man, who has lived for many years in New Mexico, begins in the Christmas *Scribner* a group of articles on that little-known territory, with its population of Pueblos, Mexicans, Navajos, and Americans. The articles will be illustrated from the author's own photographs, which are unusual in subject and variety.

— The October number of the "Papers of the American Historical Association" contains six articles. The first is a brief account of "Slavery in New York" under the colonial government. Then follow two papers on certain aspects of our national Constitution, the one on "Congressional Demands upon the Executive for Information" being the most suggestive. The next is "A Plea for Reform in the Study of English Municipal History," and there is also a longer article on the "Yazoo Land Companies," giving an account of a gigantic land speculation of a century ago, in which political intrigue played a prominent part. But the article that will be likely to interest the greatest number of readers is that on "The Lost Colony of Roanoke," by Stephen B. Weeks. The colony planted by Raleigh on Roanoke Island has always been supposed to have perished; but in 1885 Mr. Hamilton McMillan of North Carolina advanced the theory that the colonists retreated inland, where they ultimately intermarried with some friendly Indians, and that the Croatan Indians, now living in the western part of the State, are their descendants. The evidence for this theory in the physique, the traditions, and the names of those Indians is really quite striking; and persons interested in our early history will like to read Mr. Weeks's paper.

— A second edition of "Modern American Methods of Copper Smelting," by Dr. E. D. Peters, Jun., has just been published by the Scientific Publishing Company of this city. The book has met with great success, the demand for it having long since exhausted the first edition. The entire book has been practically rewritten, and new chapters have been introduced on the electrolytic assay of copper, the smelting of copper with gas in regenerative furnaces, and the smelting of copper-nickel ores in water-jackets. Additions of great importance have also been made to the chapter on reverberatory smelting, and this portion of the work has been illustrated by nine full sized pages, which form what is said to be the most complete set of detailed working drawings of the kind ever published. The arrangement of the book has been improved; and in addition to the full alphabetical index at the end, a detailed table of contents has been prepared that will be a great aid to the reader. The author has brought a riper experience to the preparation of this edition, having been actively engaged in the smelting of copper ores during the period that has elapsed since the first appearance of the book; and before preparing the new material he made a special trip through the West to note any improvements or modifications in the treatment of copper ores. The price of the book is $4.

— "Star Land," by Sir Robert Staurel Ball, F.R.S., Royal Astronomer of Ireland, published by Ginn & Co., is composed of talks with young people about the wonders of the heavens, told in a very interesting and attractive style. The well-known astronomical facts are placed before one, not in the usual cut and dried manner of the scientist and the mathematician, but well interspersed with anecdote and personal reminiscences that cannot fail to be pleasing and instructive to the amateur astronomer or to those wishing a short course in elementary astronomy.

— Ginn & Co. announce the first number of *School and College*, to be edited by Ray Greene Huling, and to appear in January, 1892. The contents will be: Some of the Next Steps Forward in Education, by E. Benjamin Andrews, president of Brown University; Secondary Education in Census Years, by James H. Blodgett, U. S. Census Office, Washington, D.C.; The Greek Method of Performing Arithmetical Operations, by John Tetlow, head-master Girls' High and Latin Schools, Boston; English in Secondary Schools, by Francis B. Gummere, professor of English in Haverford College; When Should the Study of Philosophy Begin? by B. C. Burt, formerly docent in history of philosophy at Clark University; News from Abroad; Home News; Letters to the Editor; and Reviews.

— P. Blakiston, Son, & Co., Philadelphia, will have ready Dec. 1 the new London edition of the late Dr. Carpenter's work, "The Microscope and its Revelations," edited by Professor Dallinger. This well-known book will appear in an almost entirely new form. The shape is different, owing to an enlargement of the page. Nineteen of the twenty-one full-page plates, some of which are colored, are absolutely new, and there are improvements in the woodcuts, of which there are to be 800, instead of 500, as in the previous edition. Special attention has been given to all that appertains to the practical construction and use of the instrument; but the interests of amateurs have not been neglected. The earlier chapters of the book have been entirely rewritten, and the work throughout has been brought up to date.

— *The Chautauquan* for December has several illustrated articles and portraits of a number of prominent men and women. The following titles are from the table of contents: "Domestic and Social Life of the Colonists," III., by Edward Everett Hale; "States made from Colonies," by Dr. James Albert Woodburn; "The Colonial Shire," by Albert Bushnell Hart, Ph.D.; "The History of Political Parties in America," III., by F. W. Hewes, "Physical Life," III., by Milton J. Greenman, Ph.B.; "National Agencies for Scientific Research (The Weather Bureau)," by Major J. W. Powell; "The Parasitic Enemies of Cultivated Plants," by B. T. Galloway; "The Scottish Language," by Rev. William Wye Smith; "Modern Treatment for Insanity," by C. R. Hammerton; "Moral and Social Reforms in Congress," by George Harold Walker; "Fur-Seal and the Seal Islands," by Sheldon Jackson, D.D.; "A Trip up the Nile," by Armand de Potter; "The Homes of Poverty," by Emily Huntington Miller; "Prepared Food on a Scientific Plan," by Helen M. Ellis; "Women in Astronomy," by Esther Singleton; "Qualifications Requisite for the Trained Nurse," by Lisbeth D. Price; "The German Girl of the Middle Ages.

— Professor A. D. Morse is the author of a monograph recently published by the American Academy of Political and Social Science, on "The Place of Party in Political System." It is a treatise on the philosophy of party, a subject which has been generally neglected by political scientists. After showing by what other means the State has sought to hold the government in due subordination to itself, he proves that the institution of party is the best device for accomplishing this end. He shows how party carries out its two chief functions, namely, to educate and organize public opinion, and to administer government. In regard to this latter function, he holds that under a system of party government, the party in power does the work which falls to the king in a system which is really monarchical. The monograph will doubtless create considerable discussion, as we are not wont to put so high a theoretical value to the party system.

— D. C. Heath & Co. will publish shortly "Reading and Speaking: Familiar Talks to Young Men who would Speak well in Public," by Brainard Gardner Smith, associate professor of elocution and oratory, Cornell University. Especial importance is given to the theory of sentential delivery as based on the systems of Walker and Mandeville.

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CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

Nov. 21. — William Hallock, The Deep Well at Wheeling; Robert T. Hill, On the Occurrence and Availability of Underground Water.

Society of Natural History, Boston.

Dec. 2. — A. Hyatt, Relations of Ancient and Modern Pinnas; C. S. Minot, Recent Investigations on the Brain.

SCIENCE

NEW YORK, DECEMBER 4, 1891.

DROWNING SUPERSTITIONS.

A STRANGE antipathy once prevailed to rescuing a drowning man, the idea being that the person saved would, sooner or later, do some sort of injury to the man who preserved his life, says a writer in a recent number of the *London Standard*. Sir Walter Scott, in the "Pirate," tells how Bryce, the peddler, refused to help Mordaunt to save the shipwrecked sailor from drowning, and even remonstrated with him on the rashness of such a deed. "Are you mad?" says the peddler, "you that have lived sae lang in Zetland, to risk the saving of a drowning man? Wot ye not if ye bring him to life again, he will be sure to do you some capital injury?" This prejudice, which was deeply rooted among our sea-going community in many parts of the country, existed not very long ago in Cornwall. It is found, too, among French sailors and the boatmen of the Danube, and is widely credited in Russia. Mr. Barry, in his "Ivan at Home," gives a striking instance of the Russian repugnance to save life from drowning. One day, a drunken man got into the water and disappeared. A number of spectators stood by, and gazed on the scene with the utmost indifference, but no one tried to rescue him. A court of inquiry was held, but as, on examination, no cross was found on his neck, a verdict was quickly agreed upon by the villagers, who declared that the man was "drowned because he had no cross on his neck." The Bohemian fisherman shrinks from snatching a drowning man from the waters, fearing that the water-demon would take away his luck in fishing, and drown him at the first opportunity. This, as Dr. Tylor points out in his "Primitive Culture," is a lingering survival of the ancient significance of this superstition, the explanation being that the water spirit is naturally angry at being despoiled of his victim, and henceforth bears a special grudge against the unlucky person who has dared to frustrate him. Thus, when some one is drowned in Germany, the remark is made, "The river-spirit claims his yearly sacrifice," or "The nix has taken him." Out of Europe, also, the accidental drowning of a person is attributed to a similar seizure, and the Siamese dreads the Pnük, or water-spirit, that seizes bathers and drags them under to his dwelling. The Sioux Indians have a similar fancy, and tell how men have been drowned by Unk-tahe, the water-monster. For the same reason, it appears, the Kamtchadals, far from helping a man out of the water, would drown him by force. If rescued by any chance, no one would receive such a man into his house, or give him food, but he was reckoned for dead. The Chinese reluctance to save a drowning man arises from quite a different belief — it being supposed that the spirit of a person who has met his death in this way continues to flit along the surface of the water, until it has caused, by drowning, the death of a fellow-creature. "A person, therefore," writes Mr. Jones, in his "Credulities Past and Present," "who attempts to rescue another from drowning is considered to incur the hatred of the uneasy spirit, which is desirous, even at the expense of a man's life, to escape from its wandering."

There are many curious modes of discovering the dead body of a drowned person, a popular notion being that its whereabouts may be ascertained by floating a loaf weighted with quicksilver, which is said at once to swim towards, and stand over, the spot where the body lies. This is a very widespread belief, and instances of its occurrence are, from time to time, recorded. Some years ago, a boy fell into the stream at Sherborne, Dorsetshire, and was drowned. The body not having been recovered for some days, the mode of procedure adopted was thus: A four pound loaf of best flour was procured, and a small piece cut out of the side of it, forming a cavity, into which a little quicksilver was poured. The piece was then replaced, and tied firmly in its original position. The loaf thus prepared was thrown into the river at the spot where the body fell, and was expected to float down the stream till it came to the place where the body had lodged. But no satisfactory result occurred. In Brittany, when the body of a drowned man cannot be found, a lighted taper is fixed in a loaf of bread, which is then abandoned to the retreating current. When the loaf stops, there it is supposed the body will be recovered. Under a variety of forms, the same practice is observed elsewhere, and is found existing among the North American Indians. Sir James Alexander, in his account of Canada, says: "The Indians imagine that in the case of a drowned body, its place may be discovered by floating a chip of cedar wood, which will stop and turn round over the exact spot. An instance occurred within my own knowledge, in the case of Mr. Lavery of Kingston Mill, whose boat overset, and himself drowned near Cedar Island; nor could the body be discovered until this experiment was resorted to." In Java, a live sheep is thrown into the water, and is supposed to indicate the position of the body by sinking near it. But the objects used for this purpose vary largely in different countries. A correspondent of *Notes and Queries* tells how a corpse was discovered by means of a wisp of straw, around which was tied a strip of parchment, inscribed with certain cabalistic characters, written on it by the parish priest. Not many months ago a man was drowned at St. Louis. After search had been made for the body, but without success, the man's shirt, which he had laid aside when he went in to bathe, was spread out on the water, and allowed to float away. For a while it floated, and then sank, near which spot, it is reported, the man's body was found. A curious custom is practised in Norway, where those in search of a drowned body row to and fro with a cock in the boat, fully expecting that the bird will crow when the boat reaches the spot where the corpse lies.

It was a popular theory, in days gone by, that the body of a drowned man would float on the ninth day, a notion which Mr. Henderson informs us prevails in the County of Durham. Sir Thomas Browne alludes to it as believed in his time, and, in his "Pseudodoxia Epidemica" there is a discussion on this fanciful notion. It was also believed that the spirits of those drowned at sea were doomed to wander for a hundred years, owing to the rites of burial having never been properly bestowed on their bodies, survivals of which belief linger on at the present day. According to Mr. Hunt, in his "Romances of the West of England," fishermen dread to walk at night near those parts of the shore where wrecks have taken place. It is affirmed that the spirits of the drowned sailors haunt such localities, and many a fisherman has declared that he has heard the voices of dead sailors "hailing their own names." This idea is not confined to this country, but is found in various parts of the world.

THE HABIT OF WASHING.

No practice, no custom, however long established, has ever been allowed a permanent right to respect, or even to existence. Sooner or later its turn will come to be weighed in the critic's balance, and its quality will have to be proved. Let us quote, as a recent illustration, the habit of daily bathing, the utility of which has, of late, though not for the first time, been seriously questioned. The reasonableness of doubt in such a matter, and under ordinary circumstances, does not, we confess, says *Lancet*, commend itself to our judgment. Whether the opponents of ablution fear the shock of cold immersion, or whether they dread the cleansing stimulation thus applied to the excreting skin surface, their objection must appear to most persons possessed of ordinary health and vigor to threaten impairment of both by fostering uncleanliness. If, on the other hand, it is too free application of heat by Turkish and other warm baths which appears objectionable, we will not deny that there is here a possible ground for complaint. Let it not be supposed that we ignore the curative influence or the cleansing property of this method when used with judgment. It has undoubtedly its fitting time and places if rightly applied. It is no less true, however, that experience has often proved the mischievous effects of its misuse — in case, for example, of cardiac weakness or general exhaustion. Cold bathing in like manner is not without its occasional risks. It is not suitable for persons enfeebled from any organic cause, though mere nervous languor is often braced and benefited by it. It has no proper place among the habits of those who are subject to chronic visceral congestions. As regards one advantage derived from bathing, i.e., its cleansing property, there is no reasonable ground for difference of opinion. Man, whether savage or civilized, appears, as a rule, to have no doubt on the subject. Wherever we find him with water accessible he is a bather. Less practiced by one people than another though it may be, there still is commonly recognizable a constant habit of ablution, and this fact in itself attests at least an almost universal belief in the necessity of ensuring cleanliness by means of washing. Nor can we find reason to doubt the general soundness of this belief. In bathing, temperature is, of course, a chief consideration. For the robust, cold immersion followed by rapid friction is a valuable tonic of nerve, skin, and heart function. For less vigorous constitutions — those, for example, which have been tried by disease, and those of young children — the addition of heat up to the temperate point is only judicious. With some persons a warm bath is a daily luxury. Notwithstanding its efficacy as a means of cleanliness, however, this custom is, or ought to be, discredited by its inevitable action as a nervous depressant, which places it in an unfavorable position compared with the more bracing practice of cold effusion. The benefit derived from bathing, therefore, is likely to assert itself in spite of all adverse criticism, and its mismanagement, which is only too common, should not be suffered to condemn it in the eyes of any judicious and cleanly person.

NOTES AND NEWS.

In an Austrian periodical, says the *Lancet*, a regimental surgeon named Thurnwald makes an interesting comparison between the wounds caused by the new small calibre bullets and those caused by less recent forms of projectiles. His verdict is favorable. The soft parts are less bruised, and the bones less shattered. At fighting distances the bullets hardly ever remain in the body, and the wounds are smooth, clean, and of small diameter — conditions giving fair chances of recovery.

— At the end of 1890 a census was taken of the population of the Austrian capital, which showed (*British Medical Journal*, Aug. 29, 1891) that it contained 1,380,917 inhabitants, being an increase of rather more than 23 per cent as compared with the enumeration made ten years before. The proportion of the sexes was 51 63 per cent of females to 48.37 per cent of males The number of persons suffering from mental or physical infirmity was 3,964, of whom 983, or 24 7 per cent, were blind; 980, or 24.7 per cent, were deaf and dumb; 1,627, or 41.04 per cent, were idiots or insane; and 374, or 9.44 per cent were cretins. Of the whole number, 53.13 per cent were males, and 46 87 per cent were females. The excess of males as compared with females, however, holds good only as regards cases of deaf-mutism, insanity, and idiocy; the cases of blindness are equally distributed between the sexes, and as regards cretinism, the fair sex leads easily, the respective percentages being 39 3 males to 60.7 females. On comparing these figures with those of the census of 1880, it will be seen that while blindness has diminished by nearly 10 per cent, and deaf-mutism has remained stationary, insanity and cretinism have increased by 32 per cent. This increase is greater in the female sex than in the male, in the proportion of 43.02 to 23.2 per cent. Of the 983 blind persons, only 21, or 6 per cent, were born blind; the causes of the condition are said to have been blennorrhea neonatorum (in 14 cases), small-pox (in 11), other affections (in 295), and injury (in 17). Of 381 deaf-mutes not inmates of public institutions, 127, or 33.3 per cent, became deaf and dumb after birth. Of the cretins, 63.4 per cent are between ten and thirty years of age, and 31 per cent can do ordinary household work.

— At a recent meeting of the Asiatic Society of Japan in Tokio, a paper full of curious and interesting information of the condition of the blind in Japan was read by Professor Dixon. In early ages the blind were regarded as unlucky or uncanny, and their condition was one of great misery, until one of the imperial princes was born in this state. His father collected around him a number of blind to amuse him, and when, on attaining maturity, he was appointed governor of three provinces, he took with him blind men to assist him, and for about three centuries the administration of these provinces was always in the hands of the blind. This prince also introduced the practice, which prevails at the present day, of the blind shaving their heads. During the civil contests of the twelfth and thirteenth centuries between the families of Taira and Minnamoto the blind officials were everywhere ejected, and those afflicted with loss of sight fell into their early condition of distress and misery. In course of time orders were issued to the local authorities to provide for the blind in their districts, and now they receive the attention and education usual in all civi ized countries. The members of the blind guild, which has long existed, commonly followed two occupations, music or chanting and shampooing or massage, those who practised the former being of a higher grade and frequently enjoying much popular favor. To this day all towns and villages in Japan have their blind shampooers, who go about after nightfall with a strange, musical cry. The less skilful among the musicians become professional story-tellers. The higher official grades, which were at one time opened to the blind, were eagerly sought after; those who held them were provided with special marks of their office, and during civil wars blind musicians were frequently employed as spies. The art of shampooing as practised by the Japanese blind takes nine years to learn. The pupil for the first three years practises on his master; then he spends three years acquiring the art of acupuncture; and for the remaining three years he is on probation, his master receiving half his earnings. Blind men sometimes distinguish themselves outside their regular occupations. One was a famous go player; and it is recorded that, having beaten a prince at the game, his antagonist in a fit of jealous anger killed him, and was himself executed for the crime. Another was a famous author, and compiled a valuable repertory of information in 635 volumes. The blind also practised usury, and acquired much unpopularity from the way in which they treated their debtors.

Cornet (*Zeitschrift für Hygiene*, x, 1891) has estimated that in the past fifteen years 45.82 per cent of all deaths among males, and 49.33 per cent among females, in prisons, were due to tuberculous disease. Below the age of twenty there was no material difference between the death-rate from tuberculosis among prisoners and that among the ordinary population; but between twenty and forty the death-rate was five times as high among prisoners as among the general population. Some of this excess is attributable to insufficient exercise and ventilation, and to want of variety in food. Another cause lies in the probable infection of cells by tubercle bacilli, insufficient care in disinfection being observed. In a considerable proportion of cases of tuberculosis in prisons the disease had existed prior to the incarceration, as is shown by the number of deaths from tuberculosis during the first few months of imprisonment.

— Max O'Reil is a little previous in saying in his "Frenchman in America" that St. Johnsbury, Vt, has a museum, but the Franklin Fairbanks Museum of Natural Science is to be opened to the public in a few weeks. In anticipation of the opportunities to be afforded by the museum, a Natural History Society was organized last spring. Some interesting meetings were held in Atheneum Hall but during the latter part of the summer not a large number could attend. This autumn a reorganization of the society was made, good meetings have been held, and quite a programme laid out for the winter. The meetings will be held in the hall of the museum when that is opened, where special facilities will be afforded the departments of ornithology, conchology, mineralogy, and botany for pursuit of these branches so far as collections may be an aid.

— A very valuable find of skeletons has been made in Egypt by Mr. Flinders Petrie, who has recently opened a number of tombs previously intact at Medum, belonging to the beginning of the fourth dynasty. This is the earliest known date of Egyptian remains, and that to which Egyptians ascribe themselves. The skeletons are well preserved, but tender and friable. Some of them bear unmistakable evidence of rheumatic changes, and consequently indicate that at that very remote period man was subject to and suffered from this, as is now shown from its antiquity, venerable disease. No ornaments or objects of art, except occasionally some rough pottery or a wooden headrest, were found with these remains. The greater number were interred in a contracted position with the knees drawn up to the breast, even when the tomb was long enough to allow burial in the extended position, the body placed on the left side, wrapped in linen cloth, the head always to the north and the face to the east. A few, however, apparently the bodies of the highest class or race, were interred in the extended position along with vases of stone or pottery and headrests. At this period there is no trace of mummification. The essential difference in the mode of interment seems to point to difference of race, and it is probable that the contracted burials are those of the prehistoric race of Egypt, while the dynastic race were interred with the body extended. It is extremely interesting to find these contracted burials common at so early a date in Egypt, as a similar mode was adopted by the earliest inhabitants of Great Britain. Mr. Petrie has brought the skeletons to England, and deposited them at the College of Surgeons, where they are being treated (*Brit. Med. Jour.*) so as to strengthen them and render them available for the anatomical investigation which Mr. Petrie intends to have made in order to determine, if possible, their ethnographical affinities.

— There are not many remains of the ancient Mexican feather-work which excited the surprise of the Spanish conquerors of the New World. The most famous surviving specimen is the standard, described by Hochstetter, which is now in the Vienna Ethnographical Museum. Another specimen has lately been discovered by Mrs. Zelia Nuttall in the Schloss Ambras, near Innsbruck, says *Nature*, Nov. 10. It is mentioned in an inventory, drawn up in 1596, of the treasures of the castle. This very valuable relic is the decorative part of a round shield made of interlaced reeds, and consists of feather-mosaics representing a monster, the contours of which are fastened by strips of gold. Formerly the shield was adorned with costly quetzal feathers, only small fragments of which survive. *Globus*, which has an interesting note on the subject, speaks of similar old Mexican schields in the Stuttgart Museum, and refers to a statement of Stoll to the effect that beautiful feather-ornaments are still made by the Indians of Guatemala.

— Thompson (*Lancet*, Oct. 24, 1891) has recorded the case of a blacksmith who was struck in the left eye by a fragment of flying steel. Both eyes soon displayed evidences of irritation, with considerable impairment of vision in the left. Ophthalmoscopic examination of the injured eye revealed the presence of a foreign body in the retina, together with slight exudation and hemorrhage, and a number of fine, opaque striæ in the vitreous body. The patient being etherized, the original wound was reopened and the curved pole of an electro-magnet was introduced and passed through the vitreous in a direction corresponding to that apparently traversed by the foreign body. The second application was followed by the appearance of the bit of steel "in tow" of the magnet. The small bead of vitreous that presented was snipped off, the eye was antiseptically irrigated, and a compress was applied. In the course of a short time the manifestations of irritation subsided and vision became improved, though a slight patch of opacity remained upon the retina, and the field of vision was correspondingly limited.

— At the Académie de Médecine M. Chaveau read a long paper on the relations existing between small-pox and vaccine as regards the transformation of the virus (*Medical Press*, Nov. 4). He said that the idea that vaccine was only a transformation of small-pox continued to obtain a large number of partisans. He, on the contrary, believed that the virus in both cases proceeded from the same origin. It was true the absolute proof was not yet established, but that they were distinct affections de did not doubt. Attempts were made by a Lyons committee to transform human small-pox into vaccine by inoculating cows, but the virus remained the same as to its nature even after several cultivations, consequently it must be accepted that the simple passage of pox virus in the organism of the cow or horse is entirely incapable of changing this virus into vaccine. Vaccine never produced small-pox in man, nor did human small-pox ever become vaccine when inoculated into animals. Vaccine is not, consequently, an attenuated small-pox.

— A Colombo journal gives an interesting description of the manner in which the natives of Ceylon mine for plumbago. A native usually drives a shaft until he is no longer able to contend with the flow of water in the mine. He then stops working, and afterwards drives galleries, and this he continues to do as long as his lamps will burn; but the moment they are extinguished by the gases collected in the gallery he ceases working in that part and continues upwards, refilling the shafts he has dug with the débris from the mine. In other cases, instead of sinking a shaft, a large open cutting is made, in which the vein is followed, and galleries afterwards run as occasion may require. There is no system for ventilating the mines, and the result is that after a blast much time is wasted before the mine is sufficiently cleared of foul gases to allow working to be resumed. The great object of the native proprietor is to keep his expenses as low as possible. As to the timber he is using, he knows nothing of its strength, and is quite unable to work out the strain it will stand. The result is that the shafts and galleries are frequently insufficiently timbered. The windlass used is frequently not strong enough and has no ratchet-wheel, so that serious accidents may occur in raising and lowering miners. The rope is the ordinary coir rope of the country, the strength of which varies very much according to the make and the quality of the fibre used. Instead of ropes, ladders are frequently used by the miners, and these are made of the roughest materials and frequently tied with jungle rope or ordinary coir yarn. There is no regulated distance between the rungs, and the ladder is placed perpendicularly to the bottom of the pit, and when it is remembered how highly lubricated the wood must get from the hands and feet of the natives who have been working plumbago, the great danger they run every time they mount and descend can be well conceived. Various minerals are dug out of plumbago mines with which the natives have no acquaintance, and consequently valuable minerals are sometimes thrown away. Pitchblende, known as a valuable ore of uranium, has been found inside plumbago ; pyrrhotite also is found largely in plumbago mines, from which, in other countries, the greater part of the nickel of commerce is extracted.

— The past year was a prosperous one for the Colorado College Scientific Society. The following is a complete list of papers and reports presented to the society: Oct. 14, 1890, The Abandonment of Children in Ancient Greece and Rome, by George L. Hendrickson; Recent Researches in Magnetism, by Florian Cajori; Nov. 14, Witchcraft among the Hindus, by Dr. H. W. Magoun; Dec. 11, Protection of Congressional Minorities, by W. M. Hall; Pulsations in the Aortic Arches of the Earthworm, by Miss M. R. Mann; Solidarity of the Race, by J. M. Dickey; Jan. 13, 1891, Dialectical Studies in West Virginia, by Dr. Sylvester Primer; Men for the Hour, by H. J. Barber; Feb. 10, Germ Theory of Disease, by Miss M. R. Mann; On Two Passages in the Crito, by Dr. H. W. Magoun; Mar. 24, On van't Hoff's Law of Osmotic Pressure (published in the *Chemical News*, Apr. 10, 1891), by D. J. Carnegie; The Aryan Question, by Dr. Sylvester Primer; Apr. 21, An Interpretation of the Fourth Gospel in the Light of Gnostic Philosophy, by President William F. Slocum; The Elliptic Functions Defined Independently of the Calculus, by F. H. Loud; The Study of Diophantine Analysis in the United States, by F. Cajori; May 12, Cross Ratio, by B. E. Carter, Jun.; Calibration of Burettes, by D. J. Carnegie; June 9, On a Passage in the Frogs, by Dr. H. W. Magoun; Note on the Hadley-Allen Grammar, by Dr. H. W. Magoun; Historical Note on the Differentiation of a Logarithm, by F. Cajori; A Mathematical Error in the Century Dictionary, by F. Cajori.

— The last volume of the memoirs of the Statistical Section of the Russian Geographical Society contains an interesting work by M. Borkovsky, who has devoted more than twenty-five years of his life to the study of the grain-production of Russia, and the directions in which cereals are transported within Russia both for export and for home consumption. The results, according to *Nature*, totally upset the current theory as to Russia being a granary of Europe, and are grimly confirmed by the famine which now prevails in several provinces of the empire. In appears from M. Borkovsky's figures and maps that Russia may be divided into two parts, strictly dependent on her orographical structure: one of them, which corresponds to the south eastern slope of the broad swelling which stretches across the country from south-west to north-east, has an excess of grain during the years of good crops, which excess sometimes exceeds twice or thrice the wants for local use. But there is also another part — the north-western one — which always has less corn than is wanted for its population. Taking the years 1882–85, which were years of average crops, a line traced from Kieff to Nijni-Novgorod and further north east divides Russia into two almost equal parts, of which the south-eastern exports wheat and rye into the north-western part to the amount of no less than 710,000 tons of wheat and 508,000 tons of rye, the exports to foreign countries attaining at the same time the respective figures of 1,780,000 and 1,029 600 tons. Taking into account the respective populations of the two regions, and the amount of corn consumed by the distilleries (which does not exceed 14 English pounds per inhabitant), M. Borkovsky shows that the total consumption of wheat and rye attains only the figure of 437 pounds per inhabitant (109 pounds of wheat) in the exporting region, and the still lower figure of 382 pounds (46 pounds of wheat) in the region which imports corn. The average consumption throughout Russia thus attains only 430 pounds per inhabitant, out of which 14 pounds must be deducted for the use of the distilleries. The figures will certainly seem very low if it is remembered that the great mass of the Russian peasants consume extremely small quantities of meat — bread being their chief and almost exclusive food. It appears, moreover, that if Russia exported no grain at all, and the whole of the crop of cereals were consumed within the country, the average consumption would nearly approach the average consumption in France — that is, 505 English pounds on an average year; while the surplus obtained during years of exceptionally good crops would only cover the deficit during the bad years, which recur in the steppes of South-east Russia with almost the same regularity as in India, i.e., every ten or twelve years.

— The experiment department of the Ontario Agricultural College at Guelp reports, in bulletin 49, the following experiment: In the fall of 1890 five hundred grade lambs were purchased in the eastern part of Ontario. As purchased they were turned into rape fields and fed upon the rape until Oct. 20, when ninety were selected for the experiment. These were shorn Oct. 22 and 23, and weighed October 24. They were pastured on the rape in fine weather, but kept housed in rough weather until Nov. 21, after which they were confined to the sheds and the yards in front. The shed was a large building, with ceiling 10½ feet high and hay-loft overhead. It was divided into compartments large enough to hold 16 or 17 lambs, each compartment having a small yard attached. The lambs were fed a ration consisting of oats 7 parts, oat screenings 1 part, peas 3 parts, and bran 1 part by weight, together with all the hay they would eat, and an average of three pounds of sliced turnips per day—beginning with one pound and increasing to five pounds. They were fed from November 21, 1890, to April 24, 1891, when they had consumed a total of 12,408 pounds of oats, 1,062 pounds oat screenings, 4,712 pounds peas, 1,777 pounds bran, 13.9 tons hay, and 25.15 tons turnips. The average weight of the lambs at the beginning of the experiment was 84 85 pounds, and at the end 135 pounds. The average gain per month was therefore 8.25 pounds. At the end of the experiment ten more lambs were added to the lot, making one hundred in all, and these were shipped to Liverpool, where they arrived in good condition and were sold at an average of $11.79 per head, the cost of shipment being $3.75 per head. It is stated that this cost was excessive, owing to the small number shipped, and that larger lots could be shipped at $2.50 to $3.00 per head. Of the ten lambs added to make up the hundred, five were freshly shorn and five had not been shorn at all. It was found that the autumn shorn lambs stood the journey better than either the unshorn or those freshly shorn, and that they occupied less space than the unshorn lot on shipboard.

— The following, briefly stated, are prize subjects recently proposed by the Dutch Academy of Sciences, at Haarlem: (1) Molecular theory of internal friction of gases departing from Boyle's law, and if possible, of liquids. (2) Determination of the duration of electric vibrations in various conductors. (3) Try inoculation of *Viscum album* on apple, pear, chestnut, and lime trees, and explain its preference for certain species. (4) Criticism of opinions on structure and mode of growth of the cell-wall, having regard to continuity of the protoplasm of the adjacent cells (in some cases). (5) New experiments on the reproductive power of parts of plants, and the polarity observed in it. (6) Study of the low organisms appearing (usually as filaments) in bottles containing solutions of chemical products, after long standing. (7) Significance of peptones for the circulation of nitrogen in plants. (8) Oxidation of ammoniacal salts in the ground, and transformation into nitrates. Do the microbes found by Winogradsky and Frankland exist in the soil of Holland? (9) Researches on the organism concerned in production of marsh gas, or the conditions in which the gas is formed, if life has only an indirect influence on the phenomenon. Liberation of the gas from manure. (10) Study of the microbes involved in ensilage of green fodder, and of the variations of sugar and acidity with temperature and time. (11) The development of Triclades. (12) The development of the spleen. The prize offered in each case is a gold medal or a sum of 150 florins. Memoirs may be written in Dutch, French, English, Latin, Italian, or German (not German characters), and they are to be sent in, with sealed packet, to the secretary before January 1, 1893. (Further particulars in the *Revue Scientifique*, Oct. 10, 1891.)

— A conference of educators began Nov. 2 at Newberry Library, Chicago, according to a despatch to the New York *Tribune*, to discuss the methods of executing the general design already formed of inaugurating University Extension work in Chicago. There were present President Harper of the University of Chicago, President Rogers of the North-western University, President Chamberlain of Madison University, President Eaton of Beloit University, President Coulter of the University of Indiana, Regent Burrill of the University of Illinois, Professors Moss and Forbes of the University of Michigan, Professors Turner and Freeman of Madison University, Professor Young of the North-western University, and Dr. Poole of the Newberry Library. President Rogers presided, and the session was private. There was a difference of ideas amounting almost to friction as to how university extension should be effected. The Newberry Library will equip rooms and furnish books, the public Library will assist, and instructors will be provided in abundance. But there the agreement ends. There is a radical difference of opinion as to whether the university should co-operate in the work, or each university carry on its work separate from the others. Dr. Harper stands for those who insist on separate work, and Dr. Rogers for those who insist on co-operation.

— At the meeting of the Royal Meteorological Society, Nov. 18, the following papers were read: (1) "Account of an Electric Self-Recording Rain Gauge," by Mr. W. J. E. Binnie. This is a very ingenious instrument, and has been constructed on the assumption that all drops falling from an orifice or tube are identical in weight, as long as the dimensions of the orifice are not varied. (2) "On Wet and Dry Bulb Formulæ," by Professor J. D. Everett. This is a criticism of the methods investigated some years ago by Mons. August and Dr. Apjohn for determining, by calculation, the maximum vapor tension for the dew point from the temperatures of the dry and wet bulb Professor Everett also criticises the values adopted by Regnault, and says that in presence of the uncertainty as to a rational formula, he thinks Mr. Glaisher did wisely in constructing his table of factors, which give the dew point approximately by the most direct calculation which is admissible. The inherent difficulties of hygrometric observation and deduction are great, and have not yet been fully overcome. (3) "Results of Meteorological Observations made at Akassa, Niger Territories, May, 1889, to December, 1890," by Mr. F. Russell. This was in continuation of a former communication respecting the same place. After detailing the results of the various observations, the author says that this period was very unhealthy, and the year 1890 especially so. The weather was exceptionally dry, with small-pox and phthisis amongst the native population. The West Coast reports generally were also unfavorable in reference to the condition of resident Europeans, and at the principal ports quarantine regulations were put in force, consequent upon an outbreak of yellow-fever in places situated to the south-west. At Bonny ten deaths occurred from November to February out of a population of some sixteen Europeans.

— The Brooklyn Institute December bulletin of lectures is as follows: Dec. 1, Department of Philology, lecture in the course on "The Victorian Poets," by Mrs. Abby Sage Richardson, subject, "Robert and Elizabeth Browning;" Dec. 1, Department of Entomology, lecture by Professor John B. Smith of Rutgers College on "The Morphology of the Tools and Weapons of Insects;" Dec. 2, Department of Geology, lecture by Professor William B. Scott of Princeton College on "The Age of Mammals;" Dec. 3, Department of Psychology, lecture by Professor Franklin W. Hooper on "The Physics and Psychology of Seeing;" Dec. 4, Department of Philology, second of the Shakesperian Recitals, by Mr. Hannibal A. Williams of New York, subject, "Julius Cæsar;" Dec. 4, Department of Electricity, lecture by Mr. William S. Barstow, general superintendent of the Edison Illuminating Company, on "The Direct Application of the Armature of a Motor to the Running of Machinery;" Dec. 5, Department of Chemistry, lecture by Dr. Arnold Eiloart of Cornell University on "The Arrangement of Atoms in Space, or Stereo-Chemistry;" Dec. 7, Department of Microscopy, lecture by the Rev. Frederick Carter of Montclair, N.J., on "Desmids;" Dec. 8, Department of Philology, lecture in the course on "The Victorian Poets," by Mrs. Abby Sage Richardson, subject, "Longfellow, Lowell, and Whittier contrasted;" Dec. 8, Department of Engineering, lecture by Mr. C. J. H Woodbury, vice president of the Boston Manufacturers' Fire Insurance Company of Boston, on "The Proper construction of Buildings to Resist Destruction by Fire;" Dec. 9, Department of Music, lecture by Mr. W. J. Henderson of the New York College of Music on "The Development of the French Drama;" Dec. 9, Department of Zoology, lecture by Mrs. Annie Chambers-Ketchum of Rutgers College, New York, on "The Evolution of the Lower Reptilia;" Dec. 10, Department of Painting, lecture by Mr. William Ordway Partridge on "The Practical Details of Modelling;" Dec. 10, Department of Political and Economic Science, Mr. Bolton Hall of New York has been invited to lecture. Discussion of the lecture by members of the department. Large lecture-room; Dec. 11, Department of Philology, third Shakesperian Recital, by Mr. Hannibal A. Williams, subject, "The Taming of the Shrew;" Dec. 11, Department of Geography, lecture by Mr. Charles M. Skinner of the Brooklyn *Eagle* on "The Mountain Systems of British Columbia," illustrated by photographic views of mountain scenery; Dec. 12, Department of Mathematics, lecture by Mr. Julius Henry Cone of the Brooklyn Classical School on "The Teaching of Algebra;" Dec. 14, Department of Astronomy, paper by Mr. Gardner D. Hiscock on "The Constitution of the Sun." The paper and the discussion following will be illustrated by lantern photographs; Dec. 15, Department of Philology, lecture in the course on the "Victorian Poets," by Mrs. Abby Sage Richardson, subject, "The Modern Spirit in Poetry;" Dec. 15, Department of Botany, lecture by Dr. Byron D. Halstead of Rutgers College on "Typical Forms of Cryptogamia;" Dec. 16, Department of Architecture, lecture by Mr. Russell Sturgis, president of the New York Architectural League, on "Museums for the People;" Dec. 16, Department of Mineralogy, lecture by Mr. Edgar A. Hutchins, member of the Institute, on "Quartz and its Varieties;" Dec. 17, General Meeting of the Members of the Institute, address by Professor Truman J. Backus, LL.D., president of the Packer Collegiate Institute, on "The Age of Discovery;" Dec. 18, Department of Philology, fourth Shakesperian Recital, by Mr. Hannibal A. Williams, subject, "The Winter's Tale;" Dec. 18, Department of Electricity, lecture by Mr. J. Stanford Brown on "Electrical Units in Theory and in Practice;" Dec. 19, Regular Monthly Meeting of the Council; Dec. 21, Department of Archæology, lecture by Dr. Theodore F. Wright of Cambridge, Mass., secretary of the Palestine Exploration Society, on "The Recent Archæological Explorations in Palestine;" Dec. 22, Department of Philology, last of the series of Shakesperian Recitals, by Mr. Hannibal A. Williams subject, "Othello;" Dec. 22, Department of Psychology, lecture by Dr. Thomas Balliet of Springfield, Mass., on "The Physics and Psychology of Hearing;" Dec. 23, Department of Physics, lecture on "Static Motors;" Dec. 26, Department of Archæology, organization of a section of Numismatics, lecture by Dr. Charles E. West, LL.D., president of the Department, on "Jewish Coins;" Dec. 28, Department of Photography, lecture by Mr. Wallace Gould Levison on "Photography as an Aid to Science, History, and Art;" Dec. 29, Department of Music, concert by the Beethoven Quartet Club of New York, assisted by a vocalist; Dec. 30, Department of Philology, German section, lecture by Professor Frederick W. Grube of the Boys' High School on "The Philology of the German Case Endings;" Dec. 31, General Meeting of the Members of the Institute, lecture by Mr. Garrett P. Serviss, president of the Department of Astronomy, on "The Old Year and the New," or "The Revolutions of Worlds." After paying the initiation fee of $5, associate membership in the Institute costs only $5 a year; extra tickets of admission for the month of December, $4; extra tickets for one week, $1.50; single admission, 50 cents.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

TEOHNICAL EDUCATION AT ST. ETIENNE.

FOR the past twenty years the French Government has devoted a great deal of attention to the education of the people. National schools, says the United States consul at St. Etienne, have been opened in almost every village, and the instruction given is of a very useful order. Besides the primary schools, there are superior schools where diplomas for "great merit" may be obtained. These latter, however, are only attained by pupils belonging for the most part to the middle classes, who intend to become teachers or governesses in public or private institutions, or by those who have no other purpose in view than of being considered fairly well educated. As the working classes, on the other hand, cannot afford for their children the expenditure of time and money which a course of these higher schools involves, they are obliged to withdraw them when they have received the certificate of elementary education which is generally given to children between the ages of twelve and thirteen. It is for this poorer class that towns of importance throughout France have established well-equipped schools where various trades are taught gratuitously, both practically and theoretically. St. Etienne being one of these important cities, with 113,000 inhabitants, possesses a model, well organized, and successful technical school.

The technical institution of St. Etienne was built in 1885 at a cost of $115,000. The school has three hundred students, and the trades taught are weaving, dyeing, sculpture, iron founding, cabinet making, etc. The apprenticeship is four years in duration, and the institution is free. At the end of four years, a certificate of aptitude is given, which enables the pupil to obtain a situation in the line of industrial labor which he had chosen. The work of the school begins each day at seven in the morning, and ends at seven in the evening. The school is composed of two buildings. The first is reserved for general education, and the second contains the different workshops, occupying 1,400 square metres of surface. The fitting up of these workshops is very complete, and comprises vices, lathes, boring, planing, and other machines, forges, anvils, steam-hammers, carpenters' benches, circular saws, weaving machines of every variety, and all the accessories of the dyeing industry, as well as important collections of chemical and physical apparatus. The whole building is lighted by electricity.

The lectures are of two kinds. The first are common to all students of the same year, and embrace general subjects, while the second are exclusively technical, and are special to each section. In the first year, the students pass through all the workshops to be initiated into the proper handling of the different tools, whether of iron or wood. After this period, the boys are classed according to their tastes, desires, and aptitudes. They work at manual labor three hours daily during the second year, four hours in the third, and five in the fourth and last year for the first six months, and seven hours during the last six months, in order to accustom them to the burden of a day's work. During this period, also, great attention is paid to the teaching of the theory of the different trades, that is to say, the fitters are taught to trace and cut out cog-wheels, and the carpenters to design and execute a certain number of apparatus, such as stairs of different variety, shutters, balconies, etc., on a reduced scale. The weavers, besides being taught thoroughly all the details of the loom and its working, receive special lessons in bookkeeping, legislation, commercial geography, and are taught one of the modern languages. Very careful attention is paid to design. The apprentices at all the trades are obliged to follow the instruction given on this subject, which is rightly considered of the greatest importance in the school. Designs of various kinds are executed by the more advanced sections, and every year an exhibition of the work of the boys is held.

Consul Loomis says that the results of this school have been most excellent, and he has been informed that, as a rule, its graduates become self-supporting members of society in a very short time.

THE PRODUCTION OF BUTTER.

BULLETIN No. 17 of the Pennsylvania State College Agricultural Experiment Station, by Professor Thomas F. Hunt, details some carefully conducted experiments with twelve milch cows to determine the value of cotton-seed-meal as compared with bran for the production of butter. The main inquiry was with reference to the relative effect of cotton-seed meal and bran upon the quality of the butter. The quantity of food required to produce a given quantity of butter, the effect of the food upon the health of the animals, and the effect of the food upon the completeness with which the butter fat was recovered from the milk were also subjects of research.

There were three feeding periods of four, four, and two weeks, respectively. The cows were divided into two lots of six cows each, care being taken to have the two lots as nearly comparable as may be.

Beginning with a small quantity of cotton-seed-meal, six cows were fed an increasing quantity of cotton-seed-meal until six pounds were given daily per animal. This heavy feeding of cotton-seed-meal, fed during April and May, did not affect the health of cows averaging 900 pounds each. Calves were fed one pound of cotton seed-meal daily, in skim milk, with apparently disastrous results.

The six check cows were fed bran in place of cotton-seed-meal, while all the other food offered was the same in each lot. The yield of milk was increased about one-fifth when cows were fed cotton-seed-meal instead of bran, the cotton-seed-meal constituting about three-fifths of the grain ration, and about one-fourth the total food eaten. This conclusion is reached by two comparisons which substantially check. First, the yield of milk from the cows fed cotton seed-meal was compared with that of those fed bran; and, second, the yield of milk from the cows fed cotton-seed-meal was compared with that from the same cows fed bran. This is shown in the following table, which gives the milk produced daily per animal by four cows of each lot:

	Period I.	Period II.	Period III.
	pounds.	pounds.	pounds.
Lot I.	19.4	19.5	19.0
Lot II.	23.4	23.9	19.6

Lot I. during all these periods and Lot II. during period III. were fed a ration containing bran, while Lot II. during periods I. and. II. was fed a ration containing cotton-seed-meal. We have not noticed this double method of comparing results being used in a feeding experiment heretofore. As the per cent of fat was not materially changed the quantity of butter fat was appreciably increased by feeding cotton-seed-meal in place of bran.

Butter was made both with the extractor and with the churn and deep cold-setting system, — twelve churnings with the extractor and four with the ordinary churn. With the extractor, the per cent of fat recovered was practically the same whether bran or cotton-seed-meal was fed. The per cent of fat recovered varied in ten "runs" with the extractor from 80.3 to 90.6 per cent,—averaging about 86 per cent. With the deep cold-setting system slightly more fat was left in the skim-milk and in the butter-milk when bran was fed.

Samples of butter made from eight lots of milk in which the grain ration was corn-meal and bran, and samples of butter made from the same number of lots of milk in which the bran was more or less completely displaced by cotton-seed-meal were rated by one or more commission merchants. A's score, who rated all the samples, is given in detail. He decided that the bran butter was 18 per cent better in body, 12 per cent better in smelling flavor, 9 per cent better in tasting flavor, 9 per cent better in salt, and 2.5 per cent better in color than the cotton-seed-meal butter. While there was considerable variation in opinion among the several judges, there was a general agreement that feeding cotton-seed meal reduced the quality of the butter.

The conditions of manufacture of the two kinds of butter were alike, but it is shown that cotton-seed-meal butter requires to be salted heavier than bran butter, and it is suggested that if more salt had been used in making the former as compared with the latter, the two kinds of butter might have been nearer equal in quality.

The average melting-point of eight samples of bran butter was 93° F., while that of eight samples of cotton-seed-meal butter was 99° F. The average per cent of fat was practically identical in both kinds of butter, being about 78 per cent.

SAVAGE RELIGION.

AT a meeting of the Anthropological Institute of Great Britain and Ireland, the president, Dr. Edward B. Taylor, read a paper on "The Limits of Savage Religion."

Dr. Taylor pointed out that, in defining the religious systems of the lower races so as to place them correctly in the history of culture, careful examination was necessary to separate the genuine developments of native theology from the effects of intercourse with civilized foreigners. This borrowing in some degree from the religious ideas inculcated by foreigners was generally admitted; but he said that he would show that it had taken place to a much greater extent than had been supposed. Especially through missionary influence since 1500, ideas of dualistic and monotheistic deities and of the moral government of the world had been implanted on native polytheism in various parts of the globe.

The mistaken attribution to barbaric races of theological beliefs really belonging to the cultured world, as well as the actual development among these races of new religious formations under cultured influence, had been due to three principal causes: (1) Direct adoption from foreign teachers; (2) the exaggeration of genuine native deities of a lower order into a supreme god or devil; (3) the conversion of native words denoting a whole class of minor spiritual beings, such as ghosts or demons, into individual names alleged to be those of a supreme good deity or a rival evil deity. Conspicuous among the cases of borrowing from the beliefs of a higher culture was the famous belief in the "Great Spirit" of the North American Indians. Philosophers had long been wont, on the strength of this belief, to point to the "poor Indian, whose untutored mind sees God in clouds, and hears him in the wind;" but that the "Great Spirit" belief was really the product of the tutored mind of the Jesuit missionaries in Canada was proved by their own records. In South America, among the tribes of the regions of the Orinoco, missionaries and travellers had recorded the names of great divine beings, good and evil, which, could they be received as native to these rude people, would prove that the religion of the lower culture involved a conception of a supreme creative being. Yet, when the names of these recorded deities were translated, the result threw light on their probable origin outside any native development of religion. They might variously be interpreted as "The Highest," "Lord of All," "Creator," and "Our Great Father;" and these were obviously to be attributed to the missionary teaching which had been going on for three centuries.

The Maipuri tribe explained to Father Gilij, who had written such valuable accounts of the Orinoco tribes, how their spirit Purrunaminari ("Lord of All") created man, and formed woman afterwards by extracting a rib from man during his sleep; and, further, how, again in accordance with Genesis, light was created before the sun. They had an account also reproducing the very details of the divine birth according to Christian dogma; and all this Father Gilij accepted as proof of sacred tradition having been preserved since the beginning of the human race, regardless of the fact that there had been intercourse with Europeans since 1535. These tribes had stories of a universal deluge, told as native traditions, with details plainly borrowed from European teaching, such, for instance, as the story of the great waters being sent by the "Creator," from which only one man escaped, and he in a canoe, whence he sent out a rat to see whether the water had fallen, the rat returning with an ear of Indian corn. Australia afforded much material for the illustration of the question in hand.

Since the period of European colonization, a crowd of alleged native names for the Supreme Deity and a great evil deity had been recorded. Bishop Salvado of the Benedictine Mission in West Australia gave an account of the savages' belief in an omnipotent creator called "Montogon" (believed to be a wise old man of their own race), and also in a malignant spirit, extremely feared, called "Chenga." This region and its languages had years before been excellently described and studied by Sir George Grey and by Advocate-General Moore; and, from their records, it appeared that the natives spoke of a spirit, "Mittagong," who, was, however, an insignificant demon identified with phosphoric fungus. As for "Chenga," he was not an individual at all. The dead, or the spirits of the dead, were called "djanga," and this word was applied by the savages to the white men, whom they regarded as the spirits of their forefathers returned. This misapplication of the name of a class to a particular person was largely due to the fact that communication between savages and white men was carried on in dog-English, when a few words were strung together without particles or inflections. Thus the savage, living in terror of beings closely corresponding to our ghosts or demons, learned to use the word "devil" in connection with them. The white man, accustomed to the ideas of a dominant Satan, wrote the word in his note book with a capital letter, unconscious that he was thus converting the savage's simple belief in spirits into a dualistic religion where a great personal evil was opposed to the great good being.

The German Moravian missionaries who went into the interior of Victoria in 1850 recorded that they found among the natives a belief in a spirit, "Baiame," the creator of all things, who dwelt above the clouds. Mr. W. Howitt also described this "Baiame" as he found him, and gave the following account, told by a native sorcerer, who had, according to custom, gone to "Baiame" for instruction in the supernatural: "My father had said we will go to 'Baiame's' camp. He got astride of a thread, and put me on another, and we held by each other's arms. At the end of the two threads was 'Wambu,' the bird of 'Baiame.' We went through the clouds, and on the other side was the sky. We went through the place where the doctors go through, and it kept opening and shutting very quickly. My father said that, if it touched a doctor as he was going through, it would hurt his spirit, and, when he returned home, he would sicken and die. On the other side, we saw 'Baiame' sitting in his camp. He was a very great old man, with a long beard. He sat with his legs under him, and from his shoulders extended two great quartz crystals to the sky above him. There were also numbers of the boys of 'Baiame' and his people, who are birds and beasts." These details were in some respects of very native character, while in others recalling conventional Christian pictures of the Almighty.

After adducing other illustrations from the records of explorers in Australia and Tasmania, Dr. Taylor concluded his paper by saying that, in examining a good many savage religions, he had come to the same result. In the religion of the lower races the civilized observer found himself on a familiar ground among ghosts, fairies, devils, and deities of the sky, of the sun, and of the river. Therefore, native religions extended to the distinct appreciation of gods of high rank in a polytheistic system; but to go one step further, and to look for any ideas of one supreme good being and one potent evil being, was to get beyond the religion of the lower races altogether.

AGRICULTURAL LOSSES FROM INSECTS.[1]

AT the last meeting of the association, in Champaign, Ill., I had the honor of a conversation with assistant secretary, the Hon. Edwin Willits, and he mentioned that he was frequently asked for information as to the advisability of large expenditures for entomological purposes, and that, although entomologists frequently spoke of the large losses from insects, we did not provide politicians — and particularly himself — with data by which they could explain and justify these expenditures, which those who understood them knew to be of such enormous importance, and when we wished to point out the great injuries done by insects we had to go back continuously to old published records which we had all been quoting for upwards of ten or twenty years. Now we find upon investigation that accurate estimates of damage done by insects are exceedingly difficult to arrive at, and the figures are so large that we are rather afraid to quote them ourselves lest we should prevent rather than encourage investigation, and it has been the custom of entomologists to minimize the estimates for fear they should not be believed. Now the necessity has arisen, I think, and I lay it before the association for action, in the direction of gathering together some reliable recent statistics in a short form which may be printed for distribution, and which will cover the more important injuries to date, and the part the work of the entomologist has played in reducing injury or preventing loss, so that we may overcome this difficulty and provide legislators and ourselves with data with which to meet this argument. After a careful examination and great effort to obtain data I have found that there are certain of these large estimates which appear to be reliable. I think better results will follow the publication of a few quite reliable statistics, which may be taken as typical instances, than by accumulating a large number of items which would increase the chance of error and might not be read so carefully. By way of example, I will refer to the chinch bug. I have examined carefully the estimates which have been published concerning that particular insect, and the following are probably quite reliable and appear to have been made with due regard to all collateral considerations, as the increased value of the saved crops, the cost of remedial measures, and similar subjects.

In 1864 Dr. Shimer's estimate, which I find was drawn up with very great care, put the loss in the one State of Illinois to the corn and grain crops at $73,000,000. In Dr. Riley's "Reports on the Injurious Insects of Missouri," we find in 1874 there was a reliable estimate of the loss to that State by the same insect of $19,000,000 In 1887 Professor Osborn's estimate, founded upon the reports of the correspondents of the State Agricultural Society of Iowa, put the loss in that State on corn and grain at $25,000,000; and, last, Mr. Howard's estimate, as given in the entomologist's report for 1887, for the nine States infested by the chinch bug in that year, was $60,000,000.

Now, gentlemen, I think that these statistics of the injuries to crops by one insect alone are probably as reliable as any we can get, and they give a good argument which we may use as showing the depredations of insects; but it is not sufficient that we can convince people that great injury is going on, we must show that we are doing something to mitigate this injury. In Professor Comstock's report for 1879 the estimate of the possible loss in years of general prevalence of the cotton Aletia is placed at $30,000,000 through the cotton States. The injuries by grasshoppers in the different States of the Union, and also occasionally through the British North American provinces, have been so enormous that figures hardly give an idea of the injury they do, but they are known by all to be enormous.

As an instance, however, of what may be done to mitigate their attacks, I would merely mention those for this year,

[1] From address of James Fletcher, president, at the third annual meeting of the Association of Economic Entomologists.

which seem to have been very considerable. In the States of North Dakota and Minnesota it is probable that at least $400,000 have been saved on account of work done by direct advice of entomologists — work they have in some instances forced upon the farmers. Two hundred thousand dollars is a probable estimate of the amount saved by ploughing the land last autumn. Another equal amount has been saved by the use of "hopperdozers." Professer Bruner tells me that a sufficient number of grasshoppers have been actually taken this year, which, if left alone and allowed to lay their eggs, might next year have devastated the whole crops of these two States and the adjoining parts of Manitoba. These successful operations have been carried on by the State entomologist of Minnesota, Professor Lugger, and by Professor Waldron of North Dakota, ably aided by the advice and assistance of the agent of the Department of Agriculture, Professor Bruner, under Professor Riley's instructions; and I think it is no exaggeration to say that at least $400,000 have been actually saved in hard cash on this year's crop, not to speak of the enormous loss which would most probably have followed next year had they been left alone, and had climatic conditions been favorable for their increase.

The amount of damage done to crops every year is so vast that the figures excite incredulity from those who do not study crop statistics. The agricultural products of the United States are estimated at about $3,800,000,000. Of this it is thought that about one-tenth is lost by the ravages of insects. This is in many cases unnecessary. In short, a sum of $380,000,000 is given up without a murmur and almost without a struggle by the people of the United States.

Crops of all kinds are injured, and simple remedies are known for many of the attacks, and are more or less adopted. Some have already come into general use. Paris green is now applied to potato fields almost as much as a matter of course, as manure is to fertilize the soil. As an instance of how a saving may be made even in well established methods, I give the following: Through the work of Mr. W. B. Alwood of the Virginia Experiment Station, improved machinery and the water mixtures of poisons have come into general use among the farmers and potato-growers in the Norfolk region, and some of the largest growers now claim that they at present do for from $40 to $60 what used to cost them from $500 to $600. To-day, in California and Florida, orange trees are universally treated with kerosene and resin emulsions or poisonous gas for scale insects.

In the treatment of cabbage caterpillars, pyrethrum diluted with four times its weight of common flour, and then kept tightly closed for twenty-four hours, leaves nothing to be desired, and thousands of dollars are yearly saved to small growers who most need the assistance.

Many excellent remedies have been devised by a mere modification of existing agricultural methods. Instances of these are found in the early and late sowing or harvesting of some crops, as sowing turnips between the broods of the turnip flea-beetle, the late planting of cabbage for the root-maggot, the late sowing of wheat for the Hessian-fly, etc. In the 1879 Report of the United States Department of Agriculture was first detailed the only successful method of treating the clover-seed midge by cutting or feeding off the first crop before the young larvæ are sufficiently matured to leave the heads and go into the ground to pupate. This was simply a change of one week, by which not only is the insect destroyed, but the clover is saved in better condition than under the old method.

During the present summer Professor Osborn has discovered that a serious pest of the clover plant, *Grapholitha interstinctana*, a small moth, may be destroyed in all its stages by simply stacking the hay soon after it is cut.

In the Southern States Mr. Howard Evarts Weed writes to me with regard to the cotton worm: "The loss would indeed be great were it not for the fact that the planters keep it in check by the prompt application of Paris green in a dry form. The only method now used is to apply it by means of two sacks attached to a pole and borne through the plantations by a negro mounted on a mule, who rides down the rows of plants. This gives perfect satisfaction, and the farmers of the State tell me that they want no better remedy for this insect."

Mr. F. W. Mally writes on the same subject: "The benefit which the public generally derives from the researches of economic entomologists is well illustrated by the result of the cotton-worm investigation published in the fourth report of the United States Entomological Commission. In that report estimates of damage, etc., are given, and I will only allude to the benefit which the planters have derived from the report. Formerly, planters waited until the August brood of the Aletia issued and depredated on their cotton. This brood may be called the migratory one, since it spreads over vast areas of cotton fields. At that time, too, the planters used Paris green just as they purchased it from the dealers. They have now been educated to know that the Aletia propagates in certain quite well-defined centres earlier in the season, and that if taken in July (or about five weeks earlier than they had been accustomed to), they can prevent their spreading to larger areas. Now, too, they dilute the Paris green with flour and finely-sifted wood ashes, greatly reducing the cost of the poison per acre. At the same time the acreage or area to which poison is now applied has been reduced tenfold, at least. For example, here in the Red River Valley, for 30 miles up and 50 miles down the river in July there were only two plantations (together about 2,000 acres) upon which Aletia was found. In August this brood would have spread over almost the entire section mentioned. Paris green was applied to this limited infested area, and the larger areas saved from injury. The saving is hardly to be estimated. The above appears to me to be one of the greatest triumphs of economic entomology, and, I may truthfully say, also of my most estimable chief, Dr. C. V. Riley."

With regard to another injurious insect, the following facts well illustrate what may be done by following the advice of an experienced entomologist.

During the year 1885 the Hon. Moses Fowler, a wealthy banker and landowner of Lafayette, Ind., applied to Professor F. M. Webster, an agent of the United States Department of Agriculture, then located at that place, for relief from very serious depredations by an unknown enemy to his corn, which was damaging some of his fields from 5 to 75 per cent, he having this year 10,000 acres of land devoted to this crop. Upon examination the depredator proved to be the well-known corn-root worm, the larva of *Diabrotica longicornis*. Mr. Fowler estimated the loss in his fields by reason of this insect at $10,000, with a probability of still greater injury the following year. On the advice of Mr. Webster, the next season he sowed 5,000 acres of the worst infested lands to oats, and the following year the other 5,000 acres was treated in the same manner, the first 5,000 acres being this year again devoted to corn. As a result of a continuation of this rotation the pest has been practically exterminated, thereby, according to Mr. Fowler's estimate, saving him $10,000 per annum.

Professor Osborn has shown that grass insects destroy much produce. He estimates that the small leaf-hoppers (*Jassidœ*) destroy as much food from two acres of pasture as would feed one head of stock. From recent experiments he has found that it is possible by the use of hopperdozers to reduce the numbers of these insects so materially that, upon two plots chosen for their similarity of the conditions of the growth, the amount of hay produced upon a plot which was once treated with the hopperdozer was 34 per cent greater than upon the corresponding untreated plot.

VIRCHOW, THE MAN AND THE STUDENT.[1]

By his commission the physician is sent to the sick, and, knowing in his calling neither Jew nor Gentile, bond or free, perhaps he alone rises superior to those differences which separate and make us dwell apart, too often oblivious to the common hopes and common frailties which should bind us together as a race. In his professional relations, though divided by national lines, there remains the feeling that he belongs to a Guild which owes no local allegiance, which has neither king nor country, but whose work is in the world. The Æsculapian temple has given place to the hospital, and the priestly character of the physician has vanished with the ages; still there is left with us a strong feeling of brotherhood, a sense of unity, which the limitations of language, race, and country have not been able to efface. So it has seemed meet and right to gather here this evening to do honor to a man — not of this country, not of our blood — whose life has been spent in the highest interests of humanity, whose special work has revolutionized the science of medicine, whose genius has shed lustre upon our craft.

The century now drawing to a close has seen the realization of much that the wise of old longed for, much of which the earnest spirits of the past had dreamt. It has been a century of release — a time of the loosening of bands and bonds; and medicine, too, after a long enslavement, ecclesiastical and philosophical, received its emancipation. Forsaking the traditions of the elders, and scouting the Shibboleth of schools and sects, she has at last put off the garments of her pride, and with the reed of humility in her hand sits at the feet of her mistress, the new science. Not to any one man can this revolution be ascribed; the *Zeit-geist* was potent, and like a leaven worked even in unwilling minds; but no physician of our time has done more to promote the change, or by his individual efforts to win his generation to accept it, than Rudolph Virchow.

And now, as the shadows lengthen, and ere the twilight deepens, it has seemed right to his many pupils and friends, the world over, to show their love by a gathering in his honor, on this his seventieth birthday. To-day, in Berlin, a *Fest* has been held, in which several hundred members of the profession in this and other countries have been participants, as subscribers to the fund which was organized for the occasion. It seemed well, also, to his pupils who are teachers in this university, and to others, that the event should be marked by a reunion at which we could tell over the story of his life, rejoice in his career, and express the gratitude which we on this side of the Atlantic feel to the great German physician.

Let me first lay before you a brief outline of his life:

Rudolph Virchow was born Oct. 13, 1821, at Schivelbein, a small town in Pomerania. Details of his family and of his childhood, which would be so interesting to us, are not available. Educated at the Gymnasium in Berlin, he left it at Easter, 1839, to begin his medical studies, and graduated from the university of that city in 1843. The following year he became assistant in pathological anatomy to Froriep; and in 1846 he was made prosector, and in 1847 a lecturer at the university. In 1849, on account of his active participation in the political events of the previous year, he was dismissed from his university positions, and, as he mentions, was only *mit grossen beschränkungen* reinstated, largely, in fact, by the efforts by the profession of Berlin, and particularly of the medical societies. In August, 1849, he received a call to the chair of pathological anatomy at Wurzburg, a position which he held until 1856, when, by the unanimous vote of the faculty, he was recommended for, and received the appointment which he still holds, namely, professor of pathological anatomy at Berlin. Prior to leaving Berlin he founded, in 1847, his celebrated *Archiv*, now in its one hundred and twenty-eighth volume, which is the greatest storehouse of facts in scientific medicine possessed by us to day.

Externally, at least, an uneventful, quiet, peacable life with few changes.

As an illustration of the successful pursuit of various callings, Virchow's career is without parallel in our profession, and this many-sidedness adds greatly to the interest of his life. Dr. Welch will speak of his special labors in the science of pathology; and other aspects will be considered by Dr. Chew and Dr. Friedenwald. I propose to indicate briefly a few traits in his life as a man of science and as a citizen.

From the days of the great Stageirite, who, if he never practised medicine, was at least an asclepiad and an anatomist, the intimate relation of medicine with science, has in no way been better shown than in the long array of physicians who have become distinguished in biological studies. Until the gradual differentiation of subjects, necessitated by the rapid growth of knowledge, the physician, as a matter of course, was a naturalist; and in the present era, from Galen to Huxley, the brightest minds of the profession in all countries have turned towards science as a recreation or as a pursuit. Alas! that in the present generation, with its strong bent toward specialism, this combination seems more and more impossible. We miss now the quickening spirit and the wiser insight that come with work in a wide field; and in the great cities of this country we look in vain among practising physicians for successors of Jacob Bigelow of Boston, Holmes of Montreal, Barton of Philadelphia, and others — men who maintained in this matter an honorable tradition, whose names live in natural history societies and academies of natural science, in the founding of which they were mainly instrumental.

In anthropology and archæology the name of Rudolph Virchow is almost as well known as it is in medicine. Very early in his work we find evidences of this bent in the memorable studies, now forty years ago, on cretins and on the development of the skull. Not a year has passed since that time without some notable contribution from him on these subjects; and those of us who know only his professional side may well marvel at the industry of the man whose name is quoted and appears in anthropological memoirs and journals as often as in our technical works. In recognition of his remarkable labors in this department, a special anthropological institute was organized in 1881, on the occasion of the twenty-fifth year of his professoriate. In 1884, on returning to Berlin for the first time since my student days, I took with me four choice examples of skulls of British Columbian Indians, knowing well how acceptable they would be. In his room at the Pathological Institute, surrounded by crania and skeletons, and directing his celebrated *diener*, who was mending Trojan pottery, I found the professor noting the peculiarities of a set of bones which he had just received from Madeira. Not the warm thanks, nor the cheerful, greeting which he always had for an old student, pleased me half so much as the prompt and decisive identification of the skulls which I had brought, and his rapid sketch of the cranial characters of the North American Indian. The profound expert, not the dilettante student, has characterized all of his work in this line. Even an enumeration with a brief report of his published writings in anthropological and archæological subjects would take more time than has been allotted to me. Of his relations with Schliemann I must say something, which I could not do so well as in the words used by his friend, Dr. Jacobi, ten years ago: "Schliemann, by whose modern witchcraft holy old Troy is just leaving its tomb, invited Virchow to aid him in his work of discovery of the buried city. He went — partly to aid, partly, as he says, to escape from overwhelming labors at home — only to be engrossed in just as hard work, though of a different nature. In regard to the latter, Schliemann's recent book on

[1] Address by William Osler, M.D., professor of medicine in the Johns Hopkins University, on the seventieth birthday of Professor Virchow, Oct. 13, at Baltimore.

'Ilios' contains some very interesting material. But what has engaged my attention and interest most has been to observe the humanity and indefatigability displayed by the great man in the service of the poor and sick. To read of his constant, practical exertions in behalf of the miserable population of Hissarlik; how he taught the aborigines the efficacy of chamomile and juniper, which grow about them, unnoticed and unused, in rare abundance; how a spring he laid open for archæological purposes has been called by them 'the physician's,' and is believed to have beneficial effects; how he was, on leaving the neighborhood, loaded with flowers, the only thing they had and knew would please him, has charmed me intensely. To admire a great man for his professional labors, eagerly undertaken and successfully carried out, is a great satisfaction to the scientific observer; to be able to love him, in addition, for his philanthropy and warm-heartedness, is a feast of the soul."

Virchow's life work has been the study of the processes of disease, and in the profession we revere him as the greatest master that has appeared among us since John Hunter. There is another aspect of his work which has been memorable for good to his native city. From the day when, as a young man of twenty-seven, he was sent by the Prussian Government to Upper Silesia to study the typhus epidemic, then raging among the half-starved population, he has been one of the most powerful advocates in Germany for sanitary reform; and it is not too much to say that it is largely to his efforts that the city of Berlin owes its magnificent system of drainage. His work in this department has been simply monumental, and characterized by the thoroughness which marks the specialist.

To his exhaustive monographs on camp-diseases, cholera, military medicine, and other cognate subjects, I cannot even refer.

It will be generally acknowledged that in this country doctors are, as a rule, bad citizens, taking little or no interest in civic, state, or national politics. Let me detain you a moment or two longer to tell of one of us, at least, who, in the midst of absorbing pursuits, has found time to serve his city and his country. For more than twenty years Virchow has sat in the Berlin City Council as an alderman, and to no feature in his extraordinary life does the Berliner poin with more justifiable pride. It is a combination of qualities only too rare, when the learned professor can leave his laboratory and take his share in practical, municipal work. How much his colleagues have appreciated his efforts has been shown by his election as vice-president of the Board; and on the occasion of the celebration in 1881, the *Rathhaus* was not only placed at the disposal of the committee, but the expenses of the decorations, etc, were met by the council; and to-day comes word by cable that he has been presented with the freedom of the city.

The years succeeding to Virchow's student days were full of strong political feeling, and with the French Revolution in 1848, came a general awakening. In Germany the struggle for representative government attracted many of the ardent spirits of our profession, and it was then that Virchow began his political career. The revolution was a failure, and brought nothing to the young prosector but dismissal from his public positions. His participation might have been condoned had he not issued a medico-political journal, *Die Medicinische Reform*, the numbers of which are even now very interesting reading, and contain ideas which to-day would be called liberal, but were then revolutionary. It is a striking evidence of the deep impression which even at that time Virchow had made upon his colleagues and the profession, that he was reinstated in his office at the urgent solicitation of the medical societies of the city. He relates in his "Gedächtnissrede auf Schönlein," who was the court physician and not at all in harmony with the views of his prosector, that on one occasion in 1848, at a post-mortem, in which the diagnosis of hemorrhage into the brain had been made by the professor, Virchow demonstrated an obstructing embolus in the artery. Schönlein turned to him in a half vexed, half-joking manner and said, "Sie sehen auch ueberall Barrikaden." His active political life dates from 1862, when he was elected to the lower house from one of the Berlin districts, and has, I believe, sat as member almost continuously from that date. The conditions in Germany have not been favorable to a man of advanced liberal views, and Virchow has been attached to a party which has not been conspicuously successful; but he has been an honest and industrious worker, a supporter of all measures for the relief of the people, a strenuous opponent of all class and repressive legislation, and above all an implacable enemy of absolutism as personified in Bismarck. A man of such strong individuality would make his presence felt in any assembly; and he always commanded the attention of his colleagues, and oftentimes his speeches have been reported fully both in England and in America.

As an illustration of his capacity for varied work, I recall one day in 1884, in which he gave the morning demonstration and lecture at the Pathological Institute, addressed the Town Council at great length on the extension of the canalization scheme, and made a budget speech in the House, both of which were reported at great length in the papers of the next day.

Naturally, amid such diverse occupations, it has been impossible for him to enter with his old vigor into the minutiæ of pathological anatomy, and his attitude of late years has been critical rather than productive; but his interest in all that pertains to our profession is unabated, and is a feature of his character to which I must allude. Too often with us, in our gatherings and society meetings, the "men of rathe and riper years" are conspicuous by their absence. In this respect our great master has set a notable example. Amid cares and worries, social and political, with a thousand and one ties and duties, he has never held aloof from his brethren; but, as the weekly medical journals testify, no man in Berlin has been more active, and for years he has held the presidency of the Berliner Medicinische Gesellschaft, one of the most important medical societies of Europe.

Surely the contemplation of a life so noble in its aims, so notable in its achievements, so varied in its pursuits, may well fill us with admiration for the man, and with pride that he is a member of our profession. The influence of his work has been deep and far-reaching, and in one way or another has been felt by each one of us. It is well to acknowledge the debt which we every-day practitioners owe to the great leaders and workers in the scientific branches of our art. We dwell too much in corners, and, consumed with the petty cares of a bread-and-butter struggle, forget that outside of our routine lie Elysian fields into which we may never have wandered, the tillage of which is not done by our hands, but the fruits of which we of the profession (and you of the public) fully and freely enjoy. The lesson which should sink deepest in our hearts is the answer which a life, such as Virchow's, gives to those who to-day, as in past generations, see only pills and potions in the profession of medicine, and who, utilizing the gains of science, fail to appreciate the dignity and the worth of the methods by which they are attained. As Pausanias pestered Empedocles, even to the end, for the details of the cure of Pantheia, so there are with us still those who, "asking not wisdom, but drugs to charm with," are impatient at the slow progress of science, forgetting that the chaos from which order is now appearing has been in great part dispelled by the work of one still living — by the man whom to-night we delight to honor.

BOOK-REVIEWS.

Across Russia from the Baltic to the Danube. By CHARLES AUGUSTUS STODDARD. New York, Scribner. 8°. $1.50.

STODDARD'S journey, the story of which is told in this volume, began at Paris, and extended through Sweden and Finland, to Russia, which he entered at Cronstadt. Much time was spent at St. Petersburg, and then the journey was resumed to Moscow, to which again much attention was given. The closing chapters of the book contain the account of what the author saw, or thought, while he was at Nijni-Novgorod, or was journeying west through Warsaw, the Carpathian Mountains, and Hungary, to Buda-Pesth.

The book is the narrative of one who knows how to make the stories of his wanderings entertaining. The style is that of a conversationalist rather than of the writer. Skipping along lightly from one topic to another, the author almost seems before you armed with stereopticon views of the scenes he is describing. And here it may be said that a dozen excellent illustrations are given, all of which are by the "half-tone" process from photographers, — so admirably suited to purely descriptive work. These are good examples of this kind of work, and seem unusually uniform in their clearness of detail and free from the blotches due to imperfections in the photographs.

Stoddard made no attempt to study Russia, but went to see the sights, and in this book gives a chatty account of them. At this time, when so much attention is attracted to Russia, this picture of Russian scenes will aid in gaining a clearer insight into the difficult social problems which are calling for solution within her borders.

AMONG THE PUBLISHERS.

The following tribute to the work of an American magazine is contained in the report of the Secretary of the Interior just submitted to Congress: "Your attention is also requested to the paper contributed by Mr. John Muir to the number of *The Century Illustrated Monthly Magazine* for November, 1891, entitled 'A Rival of the Yosemite — the Cañon of the South Fork of Kings River, California.' It furnishes maps of this section and is illustrated by most admirable engravings of the wonderful scenery there existing. The engravings are chiefly from the pencil of Mr. Charles D. Robinson. These gentlemen, as well as the editors of *The Century*, especially Mr. Johnson, have taken a great personal interest in the forest reserves in California, and are worthy of great consideration, both from their experience and intelligence. The magazine article mentioned advocates the extension of the Sequoia National Park so as to embrace the Kings River region and the Kaweah and Tule Sequoia groves. The boundaries are there set forth. The subject is recommended to your favorable consideration and action."

— The Scientific Publishing Company has arranged for the following books, which are now in Press: "The Phosphates of America: where and how they occur; how they are mined; and what they cost; with practical treatises on the manufacture of sulphuric acid, acid phosphate, phosphoric acid and concentrated superphosphates, and select methods of chemical Analysis," by Dr. Francis Wyatt; "Manual of Qualitative Blowpipe Analysis and Determinative Mineralogy," by Dr. F. M. Endlich; "The Chemistry of a World," by Dr. T. Sterry Hunt.

— A series of papers, "Stories of Salem Witchcraft," by Winfield S. Nevins, is begun in the December *New England Magazine.* The first article gives an account of the witchcraft cases in New England previous to 1692; the outbreak in Salem Village; the court and places of trial; a history of the trials of accused persons, and copious quotations from the remarkable testimony in the court files are given, and the article is embellished with portraits and drawings. The article is interesting at this time, as the two hundredth anniversary of this remarkable delusion is approaching.

— Longman's, Green, & Co. will publish at once a curious book, called "Japanese Letters." It is edited by Commander Hastings Berkeley, and it contains the correspondence of Tokiwara and Yashiri, giving the impressions and opinions of the former as he visits Europe for the first time.

— Houghton, Mifflin & Co. announce for immediate publication "Masterpieces of American Literature." This book contains masterpieces from the works of the following thirteen authors of America, with a biographical sketch of each : Longfellow, Whittier, Irving, Bryant, Hawthorne, Franklin, Holmes, Thoreau, O'Reilly, Lowell, Emerson, Everett and Webster.

— The Government of Honduras has placed all the ancient ruins within the borders of the republic in the care of the Peabody Museum of American Archæology and Ethnology of Harvard University for a period of ten years; giving to the museum not only the charge of the antiquities of the country, but also the exclusive right of exploration and the permission to take away one-half of all the objects found during the excavations. The museum, on its part, is to carry on explorations each year during the term covered by the decree. Professor Putnam, the director of the Honduras expedition, being unable to leave, is to be represented in the field this year (1891–1892) by two of his students — M. H. Saville, a private student and an assistant in the museum, and J. C. Owens, a student in the graduate school of Harvard, taking the course of archæology and ethnology under Professor Putnam. The expedition is thoroughly equipped, and the intention is to carry on for ten years a thorough archæological investigation at this place. The material collected this year is to be exhibited in Professor Putnam's department of the World's Columbian Exposition.

SCIENCE

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WANTED.—*Science*, No. 178, July 2, 1886, also Index and Title-page to Vol. VII. Address N. D. C. Hodges, 874 Broadway, New York.

A YOUNG MAN (31) would like a position in a college, laboratory, or observatory, is also willing to assist at a steam engine, etc. Address J. W., care of *Science*, 874 Broadway, New York.

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WANTED.—A suitable position in Washington, D. C., not connected with the Government, and with a salary not to exceed $650 a year, by an experienced biologist with six years' university training. Applicant has been a skilful surgeon for fourteen years; is a practical photographer, cartographer, and accustomed to the use of the typewriter. He is also capable of making the most finished drawings, of any description, for all manner of illustrative purposes in science; trained in museum methods and work; also field operations and taxidermy in its various departments, and modeling, production of casts, restorations of paleontological specimens and similar employments. Address U. S. R., care *Science*, 47 Lafayette Place, N. Y.

WANTED.—By a young man (27), B.A. and Ph.D., with three years' experience as assistant in chemistry, position as instructor in chemistry or in natural sciences in college or academy, or other advantageous position as chemist. Give particulars as to work, salary, etc. F. W. MAR, L. Box 23, West Haven, Conn.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

Wanted to buy or exchange a copy of Holbrook's North American Herpetology, by John Edwards. 5 vols Philadelphia, 1842. G. BAUR, Clark University, Worcester, Mass.

For sale or exchange, LeConte, "Geology;" Quain, "Anatomy," 2 vols.; Foster, "Physiology," Eng. edition; Shepard, Appleton, Elliott, and Stern, "Chemistry;" Jordan, "Manual of Vertebrates;" "International Scientists' Directory;" Vol. I. *Journal of Morphology;* Balfour, "Embryology," 2 vols.; Leidy, "Rhizopods;" *Science*, 18 vols., unbound. C. T. McCLINTOCK, Lexington, Ky.

For sale.—A 6½ x 8½ Camera; a very fine instrument, with lens, holders and tripod, all new; it cost over $40; price, $25. Edw. L. Hayes, 6 Athens street, Cambridge, Mass.

To exchange Wright's "Ice Age in North America" and Le Conte's "Elements of Geology" (Copyright 1882) for "Darwinism," by A. R. Wallace, "Origin of Species," by Darwin, "Descent of Man," by Darwin, "Man's Place in Nature," Huxley, "Mental Evolution in Animals," by Romanes, "Pre-Adamites," by Winchell. No books wanted except latest editions, and books in good condition. C. S. Brown, Jr., Vanderbilt University, Nashville, Tenn.

For Sale or Exchange for books a complete private chemical laboratory outfit. Includes large Becker balance (200g to 1-10mg), platinum dishes and crucibles, agate motors, glass-blowing apparatus, etc. For sale in part or whole. Also complete file of *Silliman's Journal*, 1862-1885 (62-71 bound); Smithsonian Reports, 1854-1883; U. S. Coast Survey, 1854-1869. Full particulars to enquirers. F. GARDINER, JR., Pomfret, Conn.

For exchange or sale at a sacrifice, an elaborate microscope outfit. Bullock stand; monocular objectives, one-sixth homeogeneous immersion, four-tenths, and three inch, Bausch & Lomb, also one-fourth and one inch Spencer. Four eye-pieces. Objectives are the best made. Address Mrs. Marion Smith, 41 Branch Street, Lowell, Mass.

SCIENCE

NEW YORK, DECEMBER 11, 1891.

HYGIENE AT ANN ARBOR.

IN the memorial which asked for the establishment of a hygienic laboratory at the University of Michigan it was stated that one of the duties of those in charge of such an institution would consist in the examination, at a nominal fee to cover actual expenses, of articles of food and drink, on request of health officers throughout the State. This has already become a very important part of the work done at the laboratory, and a brief résumé of this work may not be without interest. The present notice will speak only of articles of food examined, omitting mention of the samples of water tested, although the latter have furnished the greater part of the work.

Four samples of meat supposed to have been taken from diseased animals have been examined. In only one of these did the microscopical examination bear out the supposition, and in this the presence of trichinæ was easily recognized. It is impossible from a study of the meat as it is sold in the market to detect many of the diseases to which our domestic animals are subject. The public can be protected from this source of disease only through an examination of the living animals by a competent veterinarian.

A can of currants, which was believed to have caused serious illness, with one fatal result, in Lapeer County, was carefully studied, both chemically and bacteriologically, with negative results. It was said by the neighbors of the family that the currant bushes had been freely sprinkled with a solution of Paris green before the ripening of the berries, and it was suspected that arsenic would be found in the fruit. This very improbable supposition was found to have no support. Unfortunately, none of the ejecta of the sick, and no part of the body of the man who died, were submitted to the chemist, and the cause of the sickness will probably never be known. Certainly, if they were cases of arsenical poisoning, the arsenic was taken with some other food or drink and not in the currants.

In some canned salmon which had produced alarming symptoms, there was found a germ which, when grown on ordinary media and with free exposure to the air, produces no poison. When thus grown, the germ itself, or its products, can be injected into animals without apparent effect, but when grown in a sterilized egg, the albumen of the egg becomes markedly poisonous, a few drops being sufficient to kill a white rat. It is highly probable that in the canning of the salmon, the contents of this can were not completely sterilized, and this germ, growing in the can, from which the air was excluded, elaborated the chemical poison to which the ill effects observed in the consumer were due.

Three new poisons have been found in decomposing milk. These belong to the proteid bodies and are albuminoses. They are due to the growth of germs which have been found in the intestines of children suffering from cholera infantum; and the characteristic symptoms of this disease, followed by death, may be induced in kittens by injecting a small amount of one of these poisons under the skin. The poisons differ from one another in some of their chemical and physical properties, but their toxicological effects seem to be practically identical. It is possible, however, that a closer study of their action may reveal differences which have not yet been detected.

A poisonous albuminose has been found in cheese also. It is probable that this may form in the cheese after its manufacture, and that it does not pre-exist in the milk from which the cheese is made. At least it is certain that one portion of a cheese may be poisonous, while another portion cut from the same cheese may be eaten with impunity.

A can of mince-meat which was believed to have poisoned a number of persons has furnished a perplexing but interesting study. That the meat is poisonous can be demonstrated by feeding it to cats and dogs, and cooking does not destroy its poisonous properties. However, the most careful and thorough study has failed to reveal the nature of the poison. Mineral and vegetable poisons are not present, and ptomaïnes and poisonous proteids have not been detected in the meat.

From the studies which have been carried on in the laboratory the following conclusions, concerning the manner in which meat and milk may become infected, have been drawn: —

(1) The infection may be due to the diseased condition of the animal from which these foods are obtained.

(2) The infection may be due to the inoculation of these foods with specific, pathogenic germs outside the body of the animal.

(3) Meat and milk, especially the latter, are often infected with suprophytic toxicogenic bacteria.

The transmission of tuberculosis from the cow to the child through milk, which is known in some instances to occur, is an example under the first head. The spread of typhoid fever through milk diluted with polluted water is an example of the infection with specific germs outside of the body; while all of those instances of poisoning from the eating of partially decomposed foods demonstrate the activity of those germs which, while not capable of inducing any specific disease, do elaborate most potent chemical poisons.

The number of poisons in decomposing food is probably large, the exact nature of the one found in a given case depending upon the character of the food, the nature of the infecting germ, the temperature and the stage of growth.

THE GREAT SALT DESERT OF PERSIA.[1]

THE mountains of Siah Kuh rise to a height of about 5,000 feet above the level of the surrounding plains, which themselves constitute a plateau of about 3,000 feet to 4,000 feet above the sea-level. Looking towards the north, I could distinctly trace the course of the masonry causeway built by Shah Abbas to facilitate the communication with the south across this part of the desert, but the most remarkable feature of the landscape was that presented by the Darya-i-Namak,

[1] From a paper, by C. E. Biddulpf, in Proceedings of the Royal Geographical Society, November.

the extent of which was fairly well distinguishable from this point of vantage, in spite of the glare which surrounded it.

For miles and miles away at our feet stretched what looked in the distance a vast frozen lake, but which was in fact a deposit of salt that entirely covered the low plains towards the south, and extended as far as the eye could reach towards the east and west, glittering in the sun like a sheet of glass. Towards the extreme west we imagined that this solid sheet was replaced by water, for we fancied we could see the ripples on its surface and the foam along the edge as the wind, which was high, drove it against the shore; but this may only have been owing to the heated air upon the surface, and the broken pieces of salt which were strewn along the margin. We sat for hours looking at this strange spectacle and examining it through our field-glasses, while our guides, who were some of the wild Ilyats, or wandering tribes which haunt this neighborhood, entertained us with all manner of strange stories regarding the peculiarities of its composition and the dangers to be encountered in traversing this vast deposit of salt.

According to their accounts, it was of the consistency of ice, and, like the latter, formed a coat of varying degrees of thickness upon the top of the water or swampy ground which lay underneath it. In some places they declared that this layer of salt attained a thickness of several feet, and that with such a degree of density that laden camels and mules could cross over it with perfect safety; while in other places where this was not the case, the crust of coagulated salt would break under their weight did they attempt it, and they would be engulfed in the waters or morass below beyond all hope of extrication. There appeared to be but one path, across which only those who were in the habit of traversing it, such as the owners of camels and mules, were well acquainted with, and which no one else in consequence attempted without a competent guide, for there was but little to mark its course, and if once lost sight of, the unfortunate traveller might wander for hours or days without finding it again, and probably end by dying of thirst if he succeeded in avoiding the more dangerous parts incapable of bearing his weight, where he would inevitably be swallowed up. They told us that the passage across this plain was quite impossible by day, at any rate if the sunshine were very bright, on account of the dazzling effect which its reflection upon the white surface of the salt produced, which was such as to quite prevent persons attempting it from seeing where they were going; and they recounted numerous instances of cases which had occurred of travellers who had disappeared from losing their way, and never been heard of again. Of course it seemed to us impossible to imagine how all this could be the case, for in a saturated solution of salt and water the salt would naturally be deposited upon the bottom, and not caked upon the surface; the guides, however, were so positive about the truth of what they said, and the appearance of the plain before our eyes seemed so peculiar, that our curiosity was thoroughly aroused, and we determined in consequence to completely change our intended route for the purpose of crossing the salt, especially as the moon being just at its full, every facility was offered for doing so. Our muleteers we found to make no objection, as they said that they were in the habit of crossing by this route, and that the surface of the salt was so hard and smooth, that it presented capital footing for the baggage animals. The following evening, accordingly, we found ourselves with our whole convoy of eight camels, sixteen mules, and three horses, approaching the margin of this salt plain, which was distant about fifteen miles from the foot of the mountain. As we neared this margin, the ground, which had been hitherto hard and dry, became damp and sloppy, so that we had to confine ourselves to moving along a distinct track, which had probably been used for centuries. To judge from the appearance of the ground here, a regular swamp must extend from the salt for some distance along its margin at certain seasons of the year, for on all sides were to be seen marks of animals who had strayed off the track, and got stuck in the clayey mud, from which it would seem in many cases, from the skeletons lying about, that they had been unable to extricate themselves.

After following this track, as it wound through this swampy ground for about a mile or so, we entered upon the sheet of salt itself, which, where the incrustation was thin, as was the case for some distance from its edge, was soft and sloppy, and mixed with earth resembling very much in its appearance the edge of the ice upon a frozen pool when a thaw has set in. As we proceeded, it gained more and more in consistency, till, at a distance of three or four miles from the edge, it looked like nothing more than a surface of very solid ice, such as might have been seen on any pond in England during the course of last winter. For this indeed, so far as its appearance went, it might easily have been mistaken, had it not been that, though the whole area over which it extended was perfectly level, the surface itself was not quite even, but resembled more that of ice which had partially thawed and then frozen again after a slight fall of snow; and, further, that instead of being continuous, it was broken up into countless polygonal blocks, whose dimensions varied from about six inches across to two or three feet or more. Of the solidity of this incrustation there could be no doubt, for there we were, camels, horses, and mules, travelling over it without a vibration of any kind being perceptible, or any sign of our weight making an impression on it. After marching for about eight or ten miles upon this strange surface, we halted to examine, as far as we could by the moonlight, its composition. We tried, by means of a hammer and an iron tent-peg, to break off a block of salt to take away with us as a specimen, but found it far too hard for us to make an impression upon, and though we succeeded in bending our tent-pegs almost double, we did not accomplish our wish; we managed, however, to chip off a lot of fragments, which we found here to be of the purest white; these were quite hard when we got them, but after keeping them a day or two they took up so much moisture from the air, that they got soft and friable and changed their color to a slatey hue.

We were assured by the muleteers and others that at this distance from the edge the salt deposit was as thick as eight or ten feet, and it seemed possible from our failure in the attempt to bore into it that this might not be any great exaggeration on their part; they stated also, as I have mentioned, that under this crust lay, if not standing water, at any rate a quagmire, and that if we had succeeded in our intention of breaking through the salt, the water from beneath would have burst through the opening thus made and flooded all the surrounding space; they further told us that in the winter, when the snow fell and melted on this surface, there was always water standing upon it, and that later on, as the snows on the surrounding higher ground thawed at the approach of spring, this increased to a depth of two or three feet; but that the mules could always cross so long as it did not get too deep for them to find footing, for that the layer of salt itself never lost any of its solidity, in spite of the water lying on it.

It is difficult to explain this phenomenon except upon the theory that this incrustation is the deposit accumulated upon these low plains in the course of centuries upon centuries, during which the annual melting of the snows upon the mountains and highlands, besides the rainfall and the perennial streams which drain into this basin, have brought down in the water from the strata of salt through which they pass these tremendous quantities of salt in solution. The summer sun has dried up the water by evaporation and left the salt deposit lying upon a soil more or less saturated with moisture, this layer of salt thus deposited has gained in thickness and consistency year by year until it has become a solid homogeneous mass too firmly bound together in the parts distant from the edge, where its thickness was most (owing to the greater depth of water which accumulated there, and consequent larger amount of salt deposited), to be broken by any pressure of water from below. The perennial streams have thus poured their waters underneath this strata. as the accumulation of water would naturally commence at the lowest part of the hollow, which would be about the middle of the salt plain, while the floods of water brought down by the rain and melting snow would overflow on to its surface from the margins. This is the only way by which it occurred to us that we could account for the dead level of the crust which, though covering a space of ground more or less hollow in its nature, as was evident from the run of the water all around, did not appear to us to slope in any direction, and also for the fact that on piercing through this crust water spouted out from below. Though we had no ocular demonstration of this fact, we were satisfied that it was the case from the accounts of a party of our servants whom we sent out the following day, when we had reached the further edge, to bring us a block of salt at a distance of a mile or two from the shore; another fact in support of this theory was that nearer the edge, where the crust was thinner and thus unable to resist the pressnre from below, it had evidently been burst by the rising of the water during the winter and spring, and lay tossed about in fragments.

After this halt we continued our march and arrived at the farther margin about 3 A.M.; it had thus taken us a good eight hours to cross this plain of salt, so that the distance traversed could not have been less than about twenty miles. As we expected, wo found that, as we approached the farther side, the crust of salt got thinner and thinner, till, on one occasion, getting slightly off the track, we quickly found the horses and mules sink through it almost up to the girths in a substance that resembled exactly melting snow, out of which we had to make the best of our way towards the harder material upon which we had been marching for so many hours. At length we hit off the beaten track which had been hardened by constant use during so many centuries, and were thankful indeed when we found ourselves again at last on *terra firma*.

NOTES AND NEWS.

AT the Franklin Institute, Philadelphia, on Friday evening, Dec. 11, a lecture was delivered by Mr. William L. Saunders, the well-known civil engineer of New York, on "The Compressed Air Power of the Future."

— During the summer the third and fourth stories of the south wing of University Hall, Ann Arbor, were fitted up as zoological and botanical laboratories. Each story affords about four thousand square feet of floor space. On each floor there are three principal rooms: a central room about forty-five feet square, a north room about twenty by forty feet, and a south room of the same size. There are also small rooms for the use of instructors. The fourth floor is devoted to botany, the central room being used as a general laboratory, the north room as a herbarium, and the south room as a research-laboratory for advanced students A small conservatory is to be constructed against one of the windows of the south room and will serve for experimental work. The other south window is occupied by an equarium. The third floor is devoted to zoology, the middle room being used as a general laboratory for beginners, and the north room for advanced work in vertebrate morphology. The south room has been divided into three compartments. One of these is lined with galvanized iron and serves to house the small animals required in the daily work of the laboratory. The second is used for alcoholic specimens, and the third is fitted up as a private laboratory for the professor in charge. In the zoological laboratories particular attention has been paid to the provision of means for keeping alive the animals that inhabit our inland waters. There are four large aquaria, and provision has been made for thirty-six smaller ones. There are also cages with running water for crayfish, frogs and other small animals that do not thrive well in ordinary aquaria. Each of these laboratories, the botanical and the zoological, can accommodate about fifty students. Contrary to expectation, they are now filled to nearly their full capacity, and by another year are likely to be crowded.

— Special Agent C. J. Murphy, charged with the introduction of Indian corn as a human food into Europe, has made a report to Secretary Rusk covering his work in Great Britain. In it he reviews the conditions which seem likely to encourage the use of this cereal food in Great Britain and other parts of Europe. and points out the various channels through which he has sought to introduce it, and the necessity for the co-operation of private individuals and commercial bodies in this country to take advantage of the work already done by the Government in this direction. Secretary Rusk has caused to be prepared for publication, in conjunction with Special Agent Murphy's report, a chapter upon the value of maize as food, by Dr. H. W. Wiley, chief chemist of the department, in which are shown the chemical composition of maize and its relative value for food purposes by comparison with other cereals. There is also a chapter, prepared by the assistant statistician, Mr. B. W. Snow, under the direction of the statistician, offering some additional observations as to the possibility of extending the use of this cereal among the people of Europe as a human food, and presenting a number of statistical tables showing the yield and value of our corn crop and the extent of our available resources in supplying home and foreign demand. The report is now in press and will be shortly ready for distribution.

— In a recent paper on the camel (*Zeits. für wissen. Geogr.*) Herr Lehmann refers, among other things, to its relations to temperature and moisture. Neither the most broiling heat, nor the most intense cold, nor extreme daily or yearly variations, according to an abstract in *Nature*, hinder the distribution of the camel. It seems, indeed, that the dromedary of the Sahara has better health there than in more equably warm regions; though, after a day of tropical heat, the thermometer sometimes goes down several degrees below freezing, and daily variations of 33.7° C. occur. In Semipalatinsk again, where the camel is found, the annual variation of temperature sometimes reaches 87.3°. In Eastern Asia, winter is the time the animals are made to work. In very intense cold, they are sewn up in felt covers. Of course each race of camel does best in the temperature conditions of its home: a Soudan camel would not flourish in North-east Asia. Camels are very sensitive to moisture. In the region of tropical rains they are usually absent, and if they come into such with caravans, the results of the rainy season are greatly feared. The great humidity of the air explains the absence of the camel from the northern slopes of the Atlas, and from well-wooded Abyssinia. This sensitiveness expresses itself in the character of different races. The finest, most noble-looking camels, with short silk-like hair, are found in the interior of deserts (as in the Tuarek region, in North Africa), and they cannot be used for journeys to moist regions. Even in Fezzan (south of Tripoli) the animals are shorter and fatter, with long coarse hair; and in Nile lands, and on coasts, it is the same. These animals, too, are less serviceable as regards speed and endurance. Herr Lehmann states it as a law that the occurrence of the camel finds its limits wherever the monthly average vapor tension in the air exceeds twelve millimetres.

— A hundred years ago the natives of the valley of Chamonix who took travellers up the mountain suffered as much as their employers from physical sensations ascribed, no doubt rightly, to the rarity of the air. They were unable to walk more than a few paces without halting. Last autumn, says the Proceedings of the Royal Geographical Society, travellers who walked in early morning from the hut under the Bosses (14,000 feet) to the top (15,780 feet) had the company of five Chamoniards. They went up at a fair pace without resting. Arrived on the top, without a moment's pause, the men took their spades and shovels and began digging. They asserted that they did only about a third less work in the day than in the valley; and that they suffered no inconvenience from a prolonged stay in the Bosses hut; slept well, and ate largely. Their work was to excavate a tunnel in the summit ridge about thirty feet below the top. The object of this tunnel was to reach rock, in which a shelter-cave might be excavated. No rock had been found up to Sept. 11. The whole summit-ridge seemed to consist of compact opaque snow of exquisite purity. The rocks, a short distance from the top on the Italian side, were not considered available by the Frenchmen who were desirous of erecting the shelter. It was proposed, as no rock had been reached under the top, to carry there a wooden framework, in shape and size not unlike a bathing-machine, and fix it in the mouth of the gallery, in the hope that it might be dug out next summer and serve as a refuge for such scientific observers as might not be satisfied with the commodious hut near the Bosses.

— It has been said of more than one great and sudden sorrow, that it has eclipsed the gayety of nations, and the expression would argue a supposition that nations were, as a rule, naturally mirthful, says the *London Spectator*. Indeed, that seems to be the general idea that the world entertains of itself — namely, that it has a natural bias towards mirth and jolity, and only deviates into melancholy under the stress of untoward circumstances; that it numbers more inhabitants that are glad than those that are sorry; and that *Jean qui rit* predominates largely over *Jean qui pleure*. It is a comforting delusion — if it happens to be a delusion — and one that we should not wish to dissipate. Nevertheless, we cannot but express our doubt of its reality, for, should it ever have been true of the past, we should be driven to the most melancholy belief that the world is growing sadder as it is growing wiser, and that gayety and laughter are gradually decaying and departing from among us. That, evidently, is the opinion of one who has done his best to contribute to the mirth of his fellow-countrymen. Mr. James Payn fears that it is only too certain that people laugh less to-day than they used to do, and, at the same time as he deplores the fact, professes his inability to account for it. Of the two suggestions that he makes towards the solution of the problem, neither seems to us to be sufficient by itself to account for so dismal a change, though we have no doubt that both are factors in it. The idea of the vulgarity of laughter is neither strong enough nor sufficiently widely disseminated to have any real influence in quenching the natural expression of mirth. The innate sadness and dulness of democracy are probably much more powerful factors, in that the undeniable growth of democratic ideas among us must have brought about a corresponding decrease of mirth that provokes to laughter. But that, too, we should think, can hardly be sufficient by itself to have wrought any really perceptible change upon the mirthful spirit of the times; and yet we are fain to confess ourselves at a loss to advance any better reason for the decay of laughter, which we, as well as Mr. Payn, believe to be taking place. "Laughter holding both his sides" is well-nigh dead among us, so rarely is it heard; and the reason for its death, most people will say, is not because such laughter is vulgar and unseemly to the civilized man but because there is really nothing to-day to laugh at. Why there should be nothing now to laugh at, they would find it more difficult to explain. Hardly could they contend that we are less ludicrous than were our ancestors, or less capable of recognizing what is ludicrous. It must be some other source of laughter that is wanting in us.

— Hitherto it has not been possible to get lead to adhere to iron without the aid of tin, since lead has little or no affinity for iron, but in a new process this difficult feat is accomplished, the coating being effected with a bath of lead of about 98½ per cent purity. The plates or other articles to be coated, according to *Engineering*, are first pickled in a bath to remove scale. Through this bath a weak current of electricity is passed, which is said to reduce the time required by one-third. From this bath the articles are passed as usual into another of lime water, which neutralizes the acid, and thence into a third of clear water. They are then immersed in a fourth bath consisting of a neutral solution of zinc and stannic chlorides, obtained by dissolving granulated zinc and tin in hydrochloric acid. From this bath they are passed into a drying chamber heated by steam, where the moisture on them from the last bath is evaporated, leaving behind a deposit of the mixed metallic chlorides, which protects the plates from oxidation. When dried these plates are ready to be passed into a bath of molten lead. On issuing from this bath the plates are found to be coated with a uniform and very adherent layer of lead. Though perfectly uniform this layer is nevertheless very thin. The ductility and strength of the iron are not decreased by the process, and a plate can be bent and closed, and again opened out, without breaking the coating. In the case of galvanized iron, bending the plate to a sharp angle causes the coating to crack. Samples of ship-plates have been coated and the riveting afterwards done in the usual way without breaking the coating, which, we may also remark, takes paint very well. The thinness of the coating is remarkable, as 2 oz. per square foot of plate proves sufficient, whereas 3 oz. of spelter are in general required in galvanizing. The inventors claim that an additional economy will be effected by the fact that there is no precipitate or sediment deposit in their melting tanks, as occurs with zinc, while, at the same time, the molten lead has no effect on the material of which the bath is constructed, which may, therefore, last indefinitely.

— Drs. Emmerich and Mastraum have published an interesting article in a German Hygienic journal on the cause of immunity from infectious diseases and their treatment, especially of swine erysipelas, and a new method of protective vaccination for it. Emmerich, according to *Lancet*, published in the year 1886 his doctrine that the cause of immunity from infectious diseases is a modification of the chemical process going on in the cells, so that the new chemical compounds formed act as microbe killers without doing any harm to the cells themselves. In consequence of the results of a series of experiments, Emmerich concluded that this antibacterial poison acts destructively on all the microbes within a few hours after their introduction into the organism. The publication of this doctrine having met with a good deal of opposition, he repeated his experiments, and again arrived at the same result, showing that the explanation of immunity from infectious diseases proposed in 1886 was justified. Granted the correctness of this, it follows that extracts from the tissue of any animal enjoying immunity are remedies against the corresponding infectious disease. Further experiments are now reported by Drs. Emmerich and Mastraum which show that an extract from the various tissues and the blood of rabbits which have been made proof against swine erysipelas is an excellent remedy for the disease, and that a hypodermic injection of the extract can serve as a rational protective inoculation. A rabbit was inoculated by having injected into the posterior auricular vein the fifth of a cubic centimetre of a fresh broth culture of swine erysipelas, diluted with fifty times its volume of distilled water. In the course of the following week or two a series of hypodermic injections of the same liquid was administered. For the purpose of preparing a liquid extract suitable for therapeutic or prophylactic purposes, the organs of the rabbit were cut up and submitted to a pressure of from 300 to 400 atmospheres, and the expressed juice filtered into sterilized bottles. A large number of white mice as well as rabbits were now inoculated with the swine erysipelas, and at the same time, or very shortly afterwards, an injection of the liquid extract was administered to some of them. These remained alive, while all the others — that is to say, those which had not received an injection of the liquid extract of the organs of the infected rabbit — succumbed. Other experiments were carried out by which it was shown that this same liquid is capable of conferring immunity from the disease. Further experiments were made which showed that the bacilli were destroyed in six hours, and that in eight hours all were dead, or at least incapable of multiplication, but that the liquid extract produced extremely little effect upon the same bacilli outside the organism, so that the presence of living cells is evidently necessary for the destructive effect of the liquid extract to manifest itself. Another interesting result obtained was that bacilli taken fresh from the body were very much more active than their cultures in broth.

— A National Conference on University Extension is to be held in Philadelphia on Dec 29, 30, and 31. Representatives will attend this conference from all the leading colleges and universities of the United States and Canada, and delegates will be present from abroad. An opportunity will be given for the fullest acquaintance with this system of teaching, and discussions will be held on points in connection with its development in America.

— It is known that ozone can be abundantly produced by the electric silent discharge, and many years ago Siemens devised an "ozone-tube" for the purpose, consisting of two thin glass tubes, one within the other; the inner lined, and the outer coated, with metal, to which alternating currents of high tension are brought, acting on the gas to be ozonized within. From recent experiments in Siemens and Halske's laboratory, says *Nature*, it appears that a good result may be had with only one dielectric, and for this not only glass, but mica, celluloid, porcelain, or the like, may be used. Thus the ozone-tube may be arranged with a metallic tube within, and the outer tube a metal-coated dielectric; or the inner metal tube may have a dielectric coat, while a metal tube is the enclosing body. As metals that are little or not at all attacked by ozone, platinum, tin, tinned metals, and aluminium are recommended. Through the inner tube flows cold water, and through the space between the tubes air, dried and freed from carbonic acid. Several such tubes may be combined in a system, and worked with alternate currents (for single tubes the continuous current with commutator is best). An apparatus of this kind is now at work in the laboratory, yielding 2.4 mg. of ozone per second. Experiments are being made in supplying compressed ozone for technical use; and this has been accomplished with a pressure of nine atmospheres. One use of ozone, on which Herr Frölich lays special stress (in the recent lecture from which these data are taken), is the disinfection and sterilization of water. And doubtless with an abundant supply of the substance, the use of it would be greatly extended.

— A statement of the operations of the Missouri Geological Survey during the month of November has been issued by the State geologist, Arthur Winslow. Detailed mapping has been prosecuted in Henry and Benton Counties, and about 135 square miles have been covered. Field work of this kind is now suspended with the approach of winter, and the members of the party will be engaged during the winter months in plotting the results of the past season's work. Inspections of iron ore deposits have been made in Crawford, Dent, Phelps, Butler, Carter, Shannon, and Howell Counties. Inspections of zinc and lead deposits have been made in Crawford, Franklin, Washington, and Jefferson Counties. Inspections of coal deposits have been made in St. Clair County. The crystalline rocks have been mapped over an area of about 300 square miles in Washington, Iron, and Crawford Counties. In Greene County geological mapping has been prosecuted in six townships. Further, a small amount of work has been done in the north-western part of the State, in the study of the glacial deposits of that region. In preparation for the report on the paleontology of the State, collections have been examined in Washington, Ithaca, and New York, and much valuable material has been acquired. In the office the preliminary report on the coal deposits of the State has been finished and is now ready for the printer. The preparation of the reports on the mineral waters of the State and on the paleontology has also steadily progressed. In addition, reports on the Fredericktown and Higginsville sheets have been begun. Proofs of the latter have been received from the engraver and will soon be printed and ready for distribution. Further, much work has been done in the office upon the preparation of maps and models, and material has been collected from various railways in St. Louis for a correct dictionary of altitudes and a hypsometric map of the State. The microscopic studies of the crystalline rocks is still in progress.

— The first news that has reached Europe concerning the new Danish expedition to East Greenland is dated June 29. At that date the "Hekla" was in 71° north latitude, near Jan Mayen, and far from the east coast of Greenland. The condition of the ice this summer has rendered the navigation of the Arctic Seas extremely difficult. The pack extended far to the south, and surrounded Jan Mayen with a circular barrier. The east coast of Greenland was unapproachable, and the "Hekla" was anchored for the time in a bay of the pack. Still Captain Knutsen intended to make for the Greenland coast between 73° and 76° north latitude, the ice, according to the seal-hunters, appearing to be less dense in that quarter.

— The botanic exhibition of the Appalachian Mountain Club is to be held at the club room, 9 Park Street, Dec. 9–12, inclusive, from 10.30 A.M. to 5.30 P.M. Of the specimens of flowering plants, many are foreign; but our own local flora is well represented by collections personally obtained by club members expressly for this exhibition. A good many alpine plants are shown, from the White Mountains, the Catskills, Colorado, and Switzerland. There is a fine California collection, including supplementary flower-studies in water colors; and some excellent specimens have been brought from Alaska and British Columbia. Among the flowerless plants, there is an interesting set of more than three hundred different ferns, many of them from New Zealand, the Canary Islands, Africa, and other distant regions. Fully half of the specimens are gifts to the club, so that a good beginning of a permanent herbarium has been made.

— Some interesting experiments were recently made in Boston by Edward Atkinson, to determine some questions relating to the spontaneous ignition of wood-pulp. According to an exchange the experiments were made in an Alladin oven with a thermometer to indicate the temperature. Two slabs of wood-pulp were tied in the oven, one in contact with a loose iron shelf, the other without any contact. The first ignited at 370°, the last at 430°. In two previous tests the oven was opened when the thermometer reached 425°, but the pulp did not take fire until the introduction of air, when it ignited instantly. In speaking of the matter Mr. Atkinson says: "We have been able heretofore to imitate spontaneous combustion by putting animal or mineral oil on fibrous substances; we have tried experiments by mixing mineral or paraffine oil with animal oil to determine the exact point or proportion at which the paraffine or mineral oil will prevent oxygenation of animal or vegetable oil, but there has been no apparent means of making this oxygenation visible until the present test. This test may explain the causes of many fires. Heretofore there has been no knowledge of the ignition by rapid oxygenation of a highly-heated substance, mainly carbon or almost pure cellulose, without any admixture of grease or chemical. It would appear that finely-divided and moderately heated carbonaceous material, holding air in its pores, may ignite at a relatively lower temperature than ordinary wood. It would seem well, therefore, to avoid the use of sawdust for sweeping floors, and its storage near hot kitchens. Ice-houses are known to be bad risks. A little gudgeon-grease in the sawdust and some fresh air may explain the reason"

— Professor Clarence A. Waldo, recently of the Rose Polytechnic Institute, is now at De Pauw University, Greencastle, Ind.

— Professor M. W. Harrington having been appointed chief of the United States Weather Bureau, the astronomical observatory of the University of Michigan is temporarily in charge of the newly-appointed instructor in astronomy, Mr. W. J Hussey. The former instructor, Mr. W. W. Campbell, has accepted a position as assistant at the Lick Observatory, Mount Hamilton, Cal.

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THE APPLICATIONS OF HYPNOTISM.[1]

At the present time, when even medical experts hold themselves in an attitude of indecision towards hypnotism, it is not surprising that the laity are at a loss to reconcile the conflicting opinions of the advocates of the practice and its opponents.

There are two leading features as to the nature of hypnosis, held by the two leading schools of hypnotism. That of the Salpêtrière, enunciated by the eminent physician, Charcot, is, that hypnotism is pathological, and, in fact, a form of hysteria, and occurs in hysterical subjects only; while the Nancy school contends that hypnosis is a physiological condition analogous to natural sleep, and that nearly all persons of sane mind can be hypnotized.

Much credit is due to Charcot for his researches into hypnotism at a time when the subject was held in contempt or abhorrence; but it is to be deplored that he and his followers, by experimenting mainly on hysterical subjects — for the most part women — have forced us to regard their experiments as incomplete, and the arguments based upon them as futile. As agricultural laborers, sailors, soldiers, and the majority of children are shown to be exceptionally susceptible to hypnotism, we must, if we accept Charcot's dictum, very greatly enlarge our views as to the prevalence of hysteria; indeed, we shall be forced to assume that one-half at least of humanity are victims of this form of nervous derangement.

The fact is, that there are two kinds of hypnotism: "le grand" and "le petit." The former, which has been so developed by cultivation at the Salpêtrière as almost to constitute a new nervous disease, is undoubtedly to be seen in comparatively few subjects, which few are always of pronounced hysterical type; but the latter, "le petit hypnotisme," which is employed by Bernheim and by all physicians practising the Nancy method, is a condition of very constant occurrence. Many persons, and even some men of science, seem to imagine that by hypnotism is meant the production of such a state of unconsciousness and automatism as is seen in the subjects at the Salpêtrière, or on public platforms. But Bernheim's definition covers a much wider field. "Hypnotism," he says, "is the induction of a psychical condition in which the subject's susceptibility to suggestion and ability to act upon it are enormously increased."

Suggestion is the key to the hypnotic problem. By it the subject is put to sleep or calmed into a state of receptive quiescence, and by it he is guided in the way of cure. The degree of suggestibility is not necessarily proportioned to the depth of sleep. Some persons are barely hypnotizable, and yet a suggestion will take possession of their mind and dominate their actions; while others, even in the most profound hypnotic sleep, will refuse to receive or to act upon suggestion. As an illustration of great suggestibility accompanying a slight degree of hypnosis, I may refer to a case that has come under my own notice. The patient, whom I may call Dr. A., a university professor and a member of several learned societies, was an inveterate smoker, and hardly to be found without a cigarette in his mouth, except when he was eating or sleeping. As he was a man of highly irritable and nervous temperament and suffered from sleeplessness and atonic dyspepsia, such excessive smoking was the very worst thing for him. He knew well, and had been told by several medical men, that the habit was undermining his health and ruining his nerves, yet he found himself absolutely unable to give it up. I hypnotized him, and he fell into a state of languor resembling sleep, but without loss of consciousness. I then suggested to him that he should no longer have any desire for tobacco, and that he should feel much better for leaving it off. After a few minutes I aroused him, and found that he had a perfect recollection of every word I had said to him; but he remarked that previously, when his physicians had assured him that tobacco was poison to him and had advised him to give it up, he had mentally resented their assertions and their counsel, while now, under the influence of hypnotism, he felt that the words I had spoken were so convincing that it would be impossible to go against them. As a matter of fact, he at once gave up smoking, and I hear from him that he has felt no inclination to resume the habit. He was hypnotized only three times, and it is now eighteen months since he underwent the treatment. Still, frequently though such cases may occur in practice, we may take it as a general rule that the deeper the hypnotic effect, the greater is the influence of suggestion.

Suggestibility apart from hypnotism comes within the experience of us all. Every one has some portion of such susceptibility, and in many it is very highly developed, and may be worked upon for good or evil with signal effect. The drunkard, converted by a Gough or a Father Mathew, is redeemed through suggestion; and through it the victim of evil example or evil solicitation falls to his ruin. We are physically benefited by it when words of hope and cheerful surroundings lead us to forget bodily pain or to entertain the idea of its removal, or even to make the effort required for self-cure — as when a sufferer from functional paralysis is induced, by kindly encouragement, to move the affected limb. On the other hand, suggestion may, and continually does, work physical harm, as when some unwise sympathizer or some meddling Cassandra utters prognostications of sickness and trouble, which, by reason of the depression they induce, are likely to undermine the health of a nervous hearer.

[1] Abstract of a paper by Charles Lloyd Tuckey, M.D., in The Contemporary Review for November.

Those ills which the hypnotist can cure by suggestion, he can also frequently produce by the same method. As he can suggest the disappearance of pain, as in some forms of paralysis he can bid the return of strength and suppleness to the heavy, powerless limb, so he can induce the suffering and the impotence of disease. If, during the hypnotic trance, I tell my friend Dr. C. that on awakening he will find one leg paralyzed and feel rheumatic pains in his shoulder, the suggestion is certain to be carried out; and he drags his leg, and complains of twinges in his shoulder, until I assure him that he is cured. But Dr. C. is remarkably susceptible to hypnotism. Fortunately, a subject must generally fall into a profound sleep before he consents to receive disagreeable suggestions; whereas a slight degree of hypnosis will, in most cases, be a sufficient vehicle for those that are beneficial. I have seen the very painful and obstinate neuralgia left after "shingles" entirely and permanently removed in a few minutes by suggestion. The patient, a sailor, was very slightly influenced by hypnotism, but was extremely "suggestible."

Bernheim maintains that natural sleep is the result of auto-suggestion: we lie down in the accustomed place, at the usual hour, in the expectation of sleep, and it generally comes. He maintains also that hypnotic and natural sleep are essentially identical. While agreeing with him that there is a great similarity between the states; that natural sleep is often of the hypnotic type — for instance, the dreamless sleep of childhood; — that hypnotic sleep may frequently be used as a perfect substitute for natural sleep,— into which, indeed, it often passes,— I still believe that the two states differ from each other in several essential points.

The theory that hypnotism, when used in the treatment of moral cases, subverts free will, is erroneous. The originally healthy and well-disposed subject, who has sunk into habits of injurious self-indulgence through temptation from surroundings, exhaustion from overwork, anxiety, or some other cause outside himself, has for the time being lost his freedom of will, while the victim of an hereditary taint or congenital deficiency, who is naturally weak or vicious, or strong only in the direction of vice, may be said never to have possessed it. To the former, hypnotic suggestion will very probably restore his power of will; in the latter, the treatment may possibly develop it, especially if he be yet young, and time and patience be given to the task.

Regarding the capacity to hypnotize: no special gift seems required, though one operator may succeed in a case where another has failed. The secret of success here is the same as in other methods of medical practice, and lies in knowing when to apply the remedy, and how to gain the confidence of the patient. Several medical men of my acquaintance are easily hypnotized, but this does not prevent them from successfully hypnotizing others, any more than having been anæsthetized by chloroform oneself prevents one administering it to a patient.

The question of applying hypnotism to children, as a means of moral reformation, is a very serious one. Many people say that they would rather have their children naturally bad than hypnotically good; and I confess to feeling much sympathy with the sentiment, if the badness is within normal limits.

Voisin reports cases of older people who have been reformed by hypnotic suggestion, including some of the worst type of Parisian women, on whom other means of conversion had been vainly tried. Many of these cures, he says, have proved permanent; but my own experience leads me to fear that in such extreme cases a fresh temptation — a stronger suggestion to evil — generally causes a relapse.

Those physicians who advocate the use of hypnotism advise it, not as a specialty, but as an auxiliary, an adjunct to the practice of every medical man. It is found remarkably effective for the alleviation of pain, even in cases of incurable organic disease, such as cancer, heart disease, and locomotor ataxy; and for the relief of sleeplessness, prostration from overwork of mind or body, hysterical suffering, and such disturbances of nutrition as accompany anæmia and phthisis.

The dangers arising from the popularization of hypnotism have, I think, been overrated, though, as I have said, there is no denying that they exist, and that precautions should be taken against them. The two opposing schools of Paris and Nancy have at least one point in common: they both insist on the necessity of ordering and limiting the practice of hypnotism.

One of the most striking warnings on record against the abuse of hypnotic experiments is the story of Ilma Szandor, which Dr. von Krafft Ebing has given at length in a small volume. This young girl, a Hungarian by birth, was of hysterical constitution, and proved extraordinarily susceptible to hypnotic suggestion. She fell into the hands of persons whose ill-judged zeal and curiosity carried them to lengths which seem almost incredible, and her life was ruined by cruel and senseless experiments. She was hypnotized several times a day for some months, apparently by any one who chose to practise upon her, and was made the victim of very painful and distressing suggestions. For instance, a pair of scissors was on one occasion laid upon her bare arm, and she was told that they were red-hot, and would burn her. All the effects of a severe burn were brought about by this suggestion; an inflamed and blistered spot, taking the shape of the scissors, appeared on her arm, and took months to heal. The unhappy girl at last became insane, and, I believe, still remains so.

Professor Pitres mentions several cases where the excessive and misapplied use of hypnotism, accompanied by injurious suggestions, has been followed by grave attacks of neurasthenia; and in my own practice I have met with instances where amateur hypnotism has led to violent attacks of hysteria, followed by delusions. I have found it necessary to exercise great caution in hypnotizing hysterical and neurotic subjects. When I first began to use this treatment I wished to determine some points of interest, and for this purpose I frequently hypnotized two good subjects, one a strong, active-minded woman, the other a very muscular and robust young officer, whom I had cured of alcoholism. After a few weeks the woman began to complain of continual weariness, and of occasionally feeling dazed and confused; and the young man invariably suffered from headache if I hypnotized him more than once in the twenty-four hours, or if I made suggestions of an unpleasant or irritating character. On perceiving this I gave up experimenting on those subjects, and the unpleasant symptoms passed off in a few days. But at the time I formed the opinion, which subsequent events have strengthened, that hypnotism is not such a perfectly harmless thing as some would make it out to be, and that the hypnotic state should never be induced except under trustworthy advice, for a definite beneficial object, and by a responsible operator. If sound-minded and healthy persons suffer from being hypnotized too frequently though every care is exercised in the operation, how much greater suffering and risk must be incurred when the subjects are probably delicate and neurotic, when the hypnosis is brought about by faulty processes, and the suggestions made are almost invariably of a painful or sensational kind. Many of the subjects used for exhibition are hypnotized twice a day for months, and in consequence of this frequent repetition become reduced to a condition of automatism, vacuity, and dependence on the will of the operator, which it is painful to contemplate. The subjects chosen by public hypnotists are nearly always of a low type of intelligence, and are generally "weedy" and deficient in physical stamina. A few weeks of exhibition will probably render such subjects unfit for any subsequent employment requiring application or reasoning power.

As one of the earliest among English physicians to study the Nancy method of treatment by hypnotism, I feel it my duty to speak very plainly of the dangers attending the ignorant and injudicious use of this powerful agent. I am the more impelled to do so, because the cause of medical hypnotism has suffered through the confusion existing in the popular mind between it and the hypnotism of shows and entertainments. When people assert that hypnotism is essentially dangerous, and that its employment should be made illegal, it is as well to inquire what variety of hypnotism is referred to. If the speaker has in mind either amateur experiments or public performances, any hearer who has studied the subject must heartily endorse what he has said; but if, as is sometimes the case, no discrimination is used, and therapeutic hypnotism shares the general condemnation, we should ask, in the first place, whether it has been proved a dangerous agent in the hands of experienced medical men, and, in the second, whether its benefits are such as to justify the incurring of any risk.

In the hands of a conscientious and experienced physician the use of hypnotism is, I believe, absolutely devoid of danger. This is my own experience; and last year I wrote to the chief exponents of the treatment on the Continent, in America, and in Great Britain and Ireland, asking them for their opinion on this subject. They all replied that they had never met with untoward results, and that they could not conceive the possibility of such results if proper care and judgment were used. The venerable pioneer of suggestive hypnotism, Dr. Liébeault, who has practised for over thirty years among the poor of Nancy, gives the result of his experience in an extremely candid and interesting paper. In this he tells of two or three slight *contretemps* which happened to him in his early days of inexperience, but he goes on to say that he has never seen any serious accident occur through the use of hypnotism, and records his conviction that harm can result only through faulty method, or ignorance on the part of the operator. The fact that Dr. Liébeault has practised hypnotism so long in a comparatively small town, and that Professor Bernheim has, during the last five years, hypnotized a large proportion of the patients who have passed through the Nancy General Hospital without having any evil results to register, is, I think, a strong proof of the safety of this treatment. But even though hypnotism were proved to be attended by a certain amount of risk, we should hardly be justified in altogether prohibiting or abstaining from its use, if at the same time we could show that its advantages exceeded its drawbacks, and that it enabled us to treat successfully some diseases and conditions which resist other measures.

Among such intractable diseases, alcoholism takes a foremost place. The value of hypnotism in treating this malady may be better understood by the reader if I refer to one or two examples drawn from my own experience. Among the patients who came under my care about the end of 1888 was a successful and prosperous merchant, a member of a neurotic and alcoholized family. He had been addicted to alcohol for about three years, but drank only at intervals, between which he entirely abstained from stimulants and worked steadily at his business. When the alcoholic mania seized him he would surreptitiously leave his wife and family, and go into a mean lodging, where he could drink night and day without hindrance. His family would spend days in seeking him, and he would generally be found sleeping off the effects of a debauch. As time went on the attacks became more frequent, and between the last two only a fortnight had elapsed. He was placed under supervision and treated daily by hypnotic suggestion for about three weeks, but he was only slightly influenced by hypnotism, and always retained full consciousness. He returned home, and had no relapse for seven months, throughout which time he worked hard and regularly. In the summer of 1889 he travelled in Scotland on business, and during this journey the double shock of a thorough wetting and some bad news from home had such an effect on him that he took to whisky. He drank heavily for one day, but he was able to pull up of his own accord, and during the following week he came to see me, and to have the anti-alcoholic suggestions repeated. Since then he has continued absolutely sober, and that without any further treatment. To show the immense power wielded by hypnotism, I shall quote the case of the manager of an important company, who was on the point of being dismissed from his post when he first consulted me, early in this year. This gentleman was very susceptible to hypnotism; he fell at once into a profound sleep, and proved one of the best subjects I have ever seen. As he belonged to an alcoholized family, it was necessary to forbid him all use of stimulants; therefore he was told, while in the hypnotic state, that alcohol was poison to him, and that the taste of it would in future make him violently ill. To test the efficacy of this suggestion, a small glass of beer was given to him during the hypnotic sleep, and another about half an hour after his awaking; on both occasions the dose instantly brought on an attack of sickness, though the patient had no consciousness of the suggestions he had received. He returned to his home and business after about two months, and has had no relapse. A few weeks ago, I had a letter from his mother, informing me that he was very ill with pleurisy. The attack came on suddenly while he was attending a cricket match, and as he complained of violent pain and faintness, a well-meaning friend made him take the usual rough-and-ready remedy — a glass of whisky. He had hardly swallowed the spirit when he again rejected it, thus affording a proof of the continued action of suggestion after the lapse of three months, and under altogether exceptional circumstances.

Alcoholism is by no means the only disease originating in bad habits and want of self-control. Morphinism, for example, and the "tobacco habit," have also their victims, and the suggestive treatment which has been found useful in alcoholism has also proved efficacious against those kindred evils.

In a large proportion of cases, hypnotism should be used as an adjunct to other remedial measures, and by no means to their exclusion. And in cases of incurable disease it can be only palliative and directed to the relief of distressing symptoms, such as pain, sleeplessness, want of appetite, and mental depression. By hypnotic suggestion we can often reduce symptoms to their "anatomical expression," and take the sting from disease. Bernheim, when taunted with unwisdom because he employed hypnotism in the treatment of consumptive patients, and asked if by suggestion he expected to cure the disease and destroy the bacilli of tubercle, replied that he hypnotized those patients, not with the expectation of restoring disintegrated lung tissue, but because his suggestions relieved the wearing cough, reduced perspiration, improved the appetite, and gave refreshing sleep. If the disease was far advanced, suggestion by relieving the symptoms which constituted its sting enabled the poor sufferers to enjoy some comfort during the short spell of life remaining to them. If it had not passed the early stages there was a possibility that, by placing the patient under favorable bodily and mental conditions, reaction towards cure might be initiated and assisted.

After all, is it not the aim of most medical treatment to be thus Nature's auxiliary? The physician can aspire to do little more than place his patient in the most favorable position for cure, and thus aid that *restitutio ad integrum* which is the natural and vital reaction towards health. Some writers object to hypnotism for the reason that it removes pain without curing the disease of which it is a symptom, and aver that pain is Nature's danger signal, which should not be lowered unless the cause of danger is removed. Their objection carries little weight when hypnotism is employed by experienced physicians, who know how to interpret the signal, and who, while they try to dispel pain, do not neglect to combat the disease which it betokens. And we must not forget that in certain cases — for instance, in many forms of neuralgia — the pain is the disease, and its removal means the recovery of the patient; nor that pain is often the most distressing accompaniment of incurable disease. How can we let the poor victim of cancer or of locomotor ataxy drag out months or years of agony, when we have at hand the means of mitigating his sufferings? For such a one, the physician can often effect by hypnotism what otherwise he could effect only by narcotics and sedatives; and with this advantage, that hypnotism does not impair the mental and physical powers nor weaken the moral sense, as such drugs must do if their use be persisted in.

An objection frequently urged against hypnotism is that a person who has been subjected to it, even only once or twice, becomes over-susceptible to hypnotic influence. Repetition of the hypnotic process does generally increase susceptibility, though not to the extent which is often supposed. I have frequently seen a practised hypnotist fail absolutely to affect a subject who had many times before been under hypnotic influence. It should be the object of a medical hypnotist not to weaken but to strengthen his patient's will-power, and to make him understand that — to quote Bernheim's words — he hypnotizes himself under the guidance of the operator. It is a good plan to protect young and very susceptible subjects by impressing upon them during hypnosis that they are not to be hypnotized by any one except their own physician. I have seen sensitive persons who were thus protected resist all the efforts of the most successful hypnotists. It is hardly necessary to insist on the advisability of never hypnotizing women, nor, as a rule, very young persons, except in the presence of a responsible guardian or friend.

"RECENT Tendencies in the Reform of Land Tenure" is the title of a pamphlet lately published by the American Academy of Political and social Science. The author is Professor E. P. Cheney of the University of Pennsylvania, who has written several other essays on the land question.

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.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

A Suggestion on Telepathy.

MANY persons, when in some public place, as a street-car, church, or theatre, have felt the peculiarly unpleasant sensation that some one is staring at them from behind. Some claim to be able to make certain persons of their acquaintance look around by simply gazing fixedly at them. I am assured by one that at any public gathering she is able, without fail, to make a very self-conscious and sensitive friend look around in an annoyed manner when stared at from behind and entirely out of the range of the friend's vision. One person in seeming physical isolation appears to control another at some little distance. Such cases seem not uncommon, and scientific investigation of them might throw some light on certain cases of telepathy and hypnotism.

Some people also claim to be immediately aware of the presence of certain individuals — to have a physical intuition wholly without sense impression. This is doubtless generally due to an interpretation, unconsciously made, of various sensations which are not welded into ego-experience, and so escape memory. Yet sometimes the physical break seems so complete that any sensation seems impossible, and the feeling of presence appears to be a true telepathy. Of one thing I am convinced, namely, that we must first study all instances of what may be termed short-distance telepathy before we can expect to make much progress with long-distance telepathy. HIRAM M. STANLEY.

Lake Forest University, Dec. 2.

AMONG THE PUBLISHERS.

IN the December number of *Babyhood* there are medical articles on "Biliousness in Children," "Nursery Ventilation and Warming," and "The Care of Delicate Children."

— The New York Mathematical Society has begun the publication of a monthly bulletin. Three numbers, for October, November, and December, have already appeared. The address of the society is 41 East Forty-ninth Street, New York.

— *The Review of Reviews* will issue about the middle of December a brochure that is sure to create a sensation. It is nothing less than a compilation of anecdotes and materials upon apparitions and ghostly hallucinations, prepared by Mr. Stead, the English editor, and issued with the assistance and approbation of the British and American societies for psychical research, of which Professor Sidgwich of Cambridge University, England, and Professor James of Harvard University are in their respective countries the guiding spirits.

"Jerusalem, the Holy City," is the title of Mrs. Oliphant's new book which Messrs. Macmillan & Co. are to publish early in December, uniform in style with "The Makers of Florence," "Royal Edinburgh," etc., by the same author. It will be illustrated by Hamilton Aidĕ. The same firm will soon publish in this country "In Cairo," by William Morton Fullerton. The author formerly occupied the position of literary editor of the *Boston Advertiser*. For several years past he has lived abroad, and the book to be published embodies the result of a winter's sojourn in Egypt. It will be illustrated with drawings by Percy Anderson, the English artist, who was Mr. Fullerton's fellow-traveller in Egypt and Greece. A book of researches in the Peloponnesus, which Mr. Fullerton explored on donkey-back, will soon follow.

— The December number of the *Educational Review* completes the second volume of that journal. President Seth Low of Columbia has a suggestive paper on James Russell Lowell as an educator; Principal W. C. Collar of the Roxbury, Mass., Latin School studies the action of the colleges on the schools; Professor Joseph Jastrow contributes a psychological study of memory and association; while Dr. D. A. Sargent of Harvard discusses the subject of college athletics and heart disease. Mr. Thomas Davidson traces the development of the so-called "seven liberal arts." Other articles are by Colonel Francis W. Parker, Principal E. H. Russell of the Worcester, Mass., Normal School, and Superintendent T. H. Balliet of Springfield, Mass. The English educator, Dr. J. G. Fitch, in his letter from London, tells of the educational topics that are interesting Great Britain. An article by Professor S. S. Laurie of Edinburgh touches upon the secondary school curriculum and the question of Greek in colleges and universities.

— D. C. Heath & Co., Boston, have just published an "Italian Composition," by C. H. Grandgent, author of their Italian Grammar. Part I. supplements the Grammar by giving additional exercise work with references. Part II. comprises selections of simple Italian with exercises based on each. Part III. consists of additional exercises in composition and formulas used in letter-writing. A vocabulary, together with an appendix containing notes on pronunciation, and a list of irregular verbs follow.

— The eighth volume of the new "Chambers's Encyclopædia" will be issued by J. B. Lippincott Company in the course of a few days. It extends from Peasant to Roumelia, and contains copyright American articles on Pennsylvania, Petroleum, Philadelphia, Phonograph, William Pitt, Pittsburgh, Poetry, Prisons, Protection, Edgar Allen Poe, Railways, Rhode Island, Rocky Mountains, Roman Catholic Church, etc., together with new maps of Pennsylvania, Queensland, Rhode Island, and Roman Empire. The articles are concise yet thorough, and omit nothing that will be of practical value to the reader; the letter-press is up to the high standard of the previous volumes, and the illustrations are accurate and finished.

— An important addition to chemical literature comes from the press of J. B. Lippincott Company, entitled "The Tannins: a Monograph on Vegetable Astringents," by Henry Trimble, Ph.D. Dr. Trimble, who holds the chair of analytical chemistry in the Philadelphia College of Pharmacy, began to prepare his book about twelve years ago, but it grew under his pen to greater proportions than he at first intended, so that, as it stands before us now, it comprises a nearly complete history of the subject of which it treats. The author has had access to all the numberless publications by others which touch upon vegetable astringents and their properties, and this fact is well attested by the exhaustive bibliography which accompanies his book. The treatise, however, is not a mere compilation of the writings of accepted authorities, but it embraces the results of the author's own extensive original research.

— E. W. B. Nicholson, Bodley's librarian, is about to issue, through Mr. Quaritch in London, and the Clarendon Press Depository in Oxford, the first two of his *Bodleian Fac-simile Series*, which is to consist of faithful reproductions of some of the rarest printed works in the Bodleian. Instead of pursuing the usual course of issuing limited editions at the highest price at which a comparatively small number will buy, he intends to issue unlimited editions at the lowest prices which will allow a moderate profit. If they cannot be sold at a profit, he is still ready to go on with them, so long as they do not involve absolute loss. One of the two first issues is a photo-lithograph of the unique and perfect "Ars Moriendi; that is to saye the craft for to deye for the helthe of mannes sowle," printed about 1491 by either Caxton or Wynken de Worde. The original would probably sell for some hundreds of pounds; the fac simile, with a bibliographical introduction, will be published at eighteen pence. The other fac-simile is a photo-lithograph of a remarkable historical tract, printed at Rome in 1572, the year of the Massacre of St. Bartholomew's Day. The title is "Ordine della solennissima processione fatta dal Sommo Pontifice nell, alma citta di Roma, per la felicissima noua della destruttione della setta Vgonotana." The Bodleian copy is the only one mentioned by Brunet, or, so far as is known, by any one else; and the fac simile will be published at a shilling.

— The latest of the Johns Hopkins Studies in Historical and Political Science is a pamphlet by Professor Frederick J. Turner on "The Character and Influence of the Indian Trade in Wisconsin," originally presented as an address before the Historical Society of that State, and since rewritten and enlarged. It opens with some good remarks on the importance of trading expeditions in the history of nations, commerce having often been the pioneer in preparing the way for religion and the other higher agencies of civilization. Bancroft's assertion that the Jesuits led the way in the discovery and settlement of the North-west is contested by Professor Turner, and apparently with good reason, and he affirms that "the Jesuits followed the traders," who had already established their posts. His account of the Indian trade in his own State begins with the early French voyages, then relates the struggles between the French and the English, and afterwards between the English and the Americans for the control of that trade, and gives a brief sketch of what our Federal government afterwards did to foster and regulate the trade. He shows how important was the influence of the Indian trade in colonial times, and brings out the fact that in war time the Indians were allies of the party with whom they traded. Professor Turner's work is written in better style than many of the papers in the series to which it belongs, and it cannot fail to be of interest to all students of our Western history. The Hopkins Studies for 1892 will embrace the following: The Bishop Hill Colony, a Religious Communistic Settlement in Henry County, Illinois; Church and State in New England; Church and State in Early Maryland; The Religious Development in the Province of North Carolina; Causes of the American Revolution; Maryland's Attitude in the Struggle for Canada; Local Government in the South and South-west; and The Quakers in Pennsylvania.

— The Grolier Club's edition of Mr. George William Curtis's "Washington Irving," which will be ready for subscribers about Dec. 15, will contain portraits of Irving and Matilda Hoffman.

— The November issue of *Insect Life* (Vol IV., Nos. 3 and 4), the periodical bulletin of the Division of Entomology of the United States Department of Agriculture, contains an illustrated article by Professor C. V. Riley, on the habits and life history of the twelve-spotted diabrotica, an insect long familiar to gardeners as an enemy of squashes and melons, but which has within recent years been found to attack in the larva state and damage seriously young corn. A history of the facts bearing on this phase of the habits of the insect is given, together with a full account of its habits and development from the egg to the adult insect. It also contains an editorial article by Mr. L. O. Howard on "The Larger Corn Stalk-borer" (*Diatræa saccharalis* F.), an insect which for the past three-quarters of a century has been recognized as a serious enemy of the sugar cane in the West Indies and for a less period as an enemy of cane and corn in the Southern States, and which has been particularly abundant in the cornfields of Louisiana, where it was first recorded as early as 1857. It has since that period slowly spread throughout the Cotton Belt, and with the present season has rather suddenly appeared in Maryland and Virginia, seriously injuring corn. A full bibliographical history of the insect is given, together with a careful account of its life history and habits, illustrated by a number of text figures. This article will be of particular interest and value to the Southern planter, and also to the corn-grower of the Mississippi Valley, as the insect manifests a tendency to migrate northward, as evidenced by its appearance in Virginia and Maryland.

— Messrs. Longmans, Green, & Co. have published a "School Atlas of English History," prepared by Samuel Rawson Gardiner as a companion to his "Student's History of England." It consists of sixty-six maps and twenty-two plans of battles and sieges, all well executed and neatly colored, and illustrating every important phase of English history from the time of the Roman occupation to the present day. A large number of the earlier maps are necessarily devoted to showing the growth and later amalgamation of the various Anglish and Saxon kingdoms and the long-continued struggle for possessions in France, the shifting and often puzzling aspects of those events being elucidated in a clear and intelligible manner. The civil wars of the seventeenth century, too, are well illustrated by both maps and plans; and the growth of England's colonial and Indian empire receives careful attention. There is also a large number of maps showing the growth of the various continental states and England's relations with them; so that the book will serve to a certain extent as an atlas of European history. The plans of battles include most of the important ones from Senlac to Sebastopol; but the only one relating to colonial and American affairs is that of the siege of Quebec. Great pains have been taken to secure accuracy, a few errata being corrected in an introductory note; and the present writer at least is not competent to detect any others. Without maps in some form history is unintelligible, and it is a great convenience to have a collection specially prepared; and even those who have given considerable study to the history of England will find this atlas both interesting and useful. With its neat workmanship and excellent paper the book is well worth the dollar and a half that it costs.

— The New York History Company, 132 Nassau Street, New York, will publish at once the first volume of "The Memorial History of the City of New York," edited by General James Grant Wilson.

— Swan, Sonnenschein, & Co. will publish shortly in their Social Science Series an analysis of the first volume of Karl Marx's "Capital," by Dr. Aveling, similar to his analysis of the writings of Charles Darwin.

— An international exhibition of the book trade and its allied branches, says *The Publishers' Weekly*, will be held at the Palace of Industry at Antwerp, July to August, 1892. Application may be made to the Netherlands Society for the Promotion of the Book-trade, Amsterdam.

— Damrell & Upham, Boston, have almost ready a work by Professor Horsford concluding his researches into the coming of the Northmen, "The Landfall of Leif Erikson on Cape Cod in the Year 1000, and the Site of His Houses on the Bank of Charles River in Cambridge." An appendix will contain the Saga of Erik the Red and other documents pertaining to Vineland.

— G. P. Putnam's Sons will publish immediately an authorized edition of Charles Morley's study of dog life, entitled "Teufel, the Terrier: His Life and Adventures," and of the companion volume on "Peter, a Cat o' One Tail." The former is illustrated with designs by Yates Carrington and the latter by Louis Wain (Peter's proprietor).

— Estes & Lauriat have just issued, simultaneously with Chapman & Hall, a delightful contribution to Dickensiana entitled "A Week's Tramp in Dickens-Land." It is the record of a pilgrimage made by two enthusiastic Dickensians during the summer of 1888. Estes & Lauriat also issue an illustrated volume, by Madame de Bovet, translated and condensed by Arthur Walter, entitled "Three Months' Tour in Ireland."

— The Britannia Company of Colchester, England, makers of engineers' tools in a large way, are issuing a series of illustrated manuals giving practical information to users of tools. Their first manual, on "Turning Lathes," edited by James Lukin, is intended for technical schools and apprentices. It gives just such directions as to turning, screw-cutting, and metal-spinning which a learner would seek at the hands of an expert. In the second manual Screws and Screw-cutting are treated, with the addition of a chapter on the milling machine. The Whitworth, American, and Swiss systems of screws are described and compared, machine and hand methods of manufacture are detailed, and the rules for calculating the dimensions of screw-cutting wheels are presented with full tables for application in practice.

— Harper & Brothers will publish immediately Professor T. R. Lounsbury's "Studies in Chaucer," which is not, as might be imagined, an edition of the works of the poet, but embraces a discussion of almost every problem connected with his life and writings, including chapters on the Learning of Chaucer, the Chaucer Legend, the Text of Chaucer, Chaucer's Relation to Religion, Chaucer in Literary History, and other subjects connected with the study of his works and the time in which he lived. The work is comprised in three volumes, and is supplemented by a full index. They will publish at the same time an important work on "English Words," by Professor Charles F. Johnson of the chair of English literature, Trinity College, Hartford, which embraces an elementary study of derivation, including a discussion of the literary value of words, and, besides its value as a text-book, will be of interest to all who care to acquire correctness of diction; also "Glimpses of Nature," a collection of popular essays by Dr. Andrew Wilson of Edinburgh.

— P. Blakiston, Son, & Co., Philadelphia, have just ready the new London edition of the late Dr. Carpenter's work, "The Microscope and Its Revelations," edited by Professor Dallinger. The London *Athenæum* says: "Special attention has been given to all that appertains to the practical construction and use of the instrument, but the interests of amateurs have not been neglected. The earlier chapters of the book have been entirely rewritten, and the work throughout has been brought up to date. It is no secret that Dr. Dallinger has spent a vast amount of labor on this new edition. Mr. A. W. Bennett and Professor Jeffrey Bell have relieved him as much as possible of the work of revising the chapters on botany and zoology."

— *The Popular Science Monthly* is rapidly coming to the front as an illustrated magazine. Until recently it published only a few simple drawings, where they were specially needed to supplement the text, but the January number is to have no less than sixty illustrations. The kinship which Darwinism recognizes between man and the brutes is strongly confirmed by the facts contained in an article on "Tail-like Formations in Men." The researches of several German physiologists are here presented, and pictures of a number of these strange formations are given. "Theology and Political Economy" is the subject of Dr. Andrew D. White's next chapter in his Warfare of Science series. Paying for the use of money is the matter in which the Church has most seriously obstructed commerce, and a full history of the conflict over interest is given in this article. An illustrated sketch of certain "Remarkable Bowlders," by Mr. David A. Wells, is to appear. Mr. Carroll D. Wright will have a study of "Our Population and its Distribution," showing the movement of the centre of population westward, and how the people are distributed with respect to topographical features of the country, rainfall, humidity, etc. All interested in the teaching of young children will be glad to read Mrs. Mary Alling Aber's account of "An Experiment in Education." It is a sample of the sporadic efforts to introduce little children to real knowledge, which promises valuable results in the near future.

— The sixth, and last, volume of "The Century Dictionary" is now ready, and contains 1,046 pages, beginning with the word *strub*. Its successful completion, substantially within the time originally announced by the publishers, is a notable event. The preface issued with the first part is dated May 1, 1889, the supplementary note to the preface issued with the last part, Oct. 1, 1891. Between these dates has been published, in twenty-four parts, which have followed each other with almost mechanical regularity, a dictionary of 7,046 large quarto pages, containing, from the printer's point of view, two-thirds as much matter as the "Encyclopædia Britannica," and including about 500,000 definitions of over 215,000 words, 50,000 defined phrases, 300,000 illustrative quotations, and 8,000 cuts. The sixth volume contains its full share of important and interesting articles. The definitions of *sun* and *sun spot* (both by Professor C. A. Young) with their engravings illustrate well its encyclopedic richness, as do also such articles as those under *transit*, *temple*, *swallow*, *sub-*, *substance*, *trot* (with its reproduction of instantaneous photographs by Muybridge), *trust*, etc. The volume also exhibits the usual large number of admirable cuts, such as those under *tabard*, *testudo*, *tiger*, *toboggan*, *tomb*, *tube* (pneumatic), *tunnel*, *typesetting-machine*, *Venus*, *victory*, *Vides-trelda*, *Vidua*, *Viduinæ*. It closes with a list of over 3,000 authors and authorities cited in the course of the work, and with what is, perhaps, the most interesting single thing it contains, a reprint of the list of amended spellings recommended by the English Philological Society and the American Philological Association, headed by an introduction which leaves no doubt where the editors of the dictionary stand as regards spelling-reform. While this list, which has as yet almost no actual usage to support it, and was indeed intended only as a step toward something more complete, could not properly be incorporated in the body of the dictionary, Professor Whitney believes that no lexicographer should ignore it. He expresses his opinion in the following vigorous language: "The reformed orthography of the present, made with scientific intent and with a regard for historic and phonetic truth, is more worthy of notice, if a dictionary could discriminate as to worthiness between two sets of facts, than the oftentimes capricious and ignorant orthography of the past. It need not be said in this dictionary that the objections brought on etymological and literary and other grounds against the correction of English spelling are the unthinking expressions of ignorance and prejudice. All English etymologists are in favor of the correction of English spelling, both on etymological grounds and on the higher ground of the great service it will render to national education and international intercourse. It may safely be said that no competent scholar who has really examined the question has come, or could come, to a different conclusion; and it may confidently be predicted that future English dictionaries will be able to recognize to the full, as this dictionary has been able in its own usage to recognize in part, the right of the English vocabulary to be rightly spelled." These principles, as the last sentence quoted intimates, have, as far as possible, been carried out in the dictionary with regard to the spelling of words the orthography of which varies, by the adoption of the simplest or most "phonetic" form; and "The Century" is thus the first dictionary to support both by practice and preaching this great movement of philological reason and of common sense.

— The ethnographic parallel between Israelite and Indian, which was published by Colonel Garrick Mallery in the *Popular Science Monthly*, in 1889, has been translated into German, by Dr. Friedrich S. Krauss, the German ethnologist. "Israeliten und Indianer" (Leipzig, Grieben, 1891, pp. 106, 12°) is the title of the version, which renders the thoughts of the original in good German and in a free and easy style. The preface also contains a biography of the author, who is a member of the Bureau of Ethnology in Washington. The article forcibly refutes the existence of monotheism among the Indians, and none of the languages has any word corresponding to our term God. The differences between the Jewish and the Indian institutions and mode of life are thoroughgoing, but, nevertheless, there are many similarities of striking nature, based on the simplicity of life to be met with with primitive nations, and Mallery has sought everywhere to point out the causes on which they are based.

— The ornamental designs and symbols found on American pottery, implements, objects carved in wood, and other utensils, have been discussed from the genetic and historical standpoint by Professor Alois R. Hein of the Vienna University ("Mäander, Kreuze, Hakenkreuze und urmotivische Wirbelornamente in

CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

Dec. 5.—R. S. Woodward, Maxwell's Theory of Electrostatics; J. F. Hayford, The Detection by Azimuth Observations of Variations in the Pole or the Vertical; A Recent Check on the Relation between the Metric Units of Length and Mass.

Natural Science Association, Staten Island.

Nov. 14.—Election of officers: president, N. L. Britton; treasurer, Eberhard Faber; recording secretary, C. F. Simons; corresponding secretary, Arthur Hollick; curator, Joseph C. Thompson.

Appalachian Mountain Club, Boston.

Dec. 8.—Rosewell B. Lawrence and Percival Lowell, Bandaisan, Miomote, and Matsushima, two papers, descriptive of a trip in North-western Japan.

Amerika," Wien, Hölder, 1891, 8°, illustrated, pp. 48). Hein's object is to trace the causal connection existing between the ornaments of the most primitive nations and the products of art in its most refined and accomplished stage. The ornamental display found among the so-called "savages" has been entirely neglected by the esthetic school of ornamentists, and still here it is where we have to look for the origin of this speciality in art. The meander and the Cyma are found highly developed on South American tissues and other manufactures; the cross is a decoration as well as a mystic symbol in both hemispheres, although in this part of the world it meant the winds, the four points of the compass, and the rain-god. A figure resembling the hooked cross, or swastika, is found on South American vases, baskets, and shell-engravings. The Mexican hieroglyphs for *year* and *time* differ but little from the svastika of India, and, like it, is intended to mark rotation. For its manifold useful hints we recommend Hein's pamphlet to all artists and art historiographers.

— *The Political Science Quarterly* for December opens with an article by Professor A. D. Morse of Amherst College on "The Democratic Party," in its historical origin and its present tasks. Paul L. Ford describes the non-intercourse policy of the colonists in 1774, under "The Association of the First Congress;" Charles B. Spahr, writing of "The Single Tax," combats the practicability of Mr. George's panacea; Professor F. A. Giddings, discussing "Sociology as a University Study," makes suggestions as to the character of the new science; Professor D. G. Ritchie of Oxford contributes valuable material in the "History of the Social Contract Theory;" M. Ostrogovski presents a careful and exhaustive study of "Woman Suffrage in Local Self-Government;" and Dr. Frederic Bancroft, with recent publications as his text, writes sympathetically of "Lincoln and Seward" and critically of "Their Latest Biographers." Some twenty-five books are noticed in the department of reviews, and Professor William A. Dunning brings his "Record of Political Events" down to Nov. 1.

SCIENCE

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QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19. No response to date.

N. D. C. HODGES,
874 BROADWAY, NEW YORK.

CALENDAR OF SOCIETIES.

Society of Natural History, Boston.

Dec. 16.—J. C. White, Sketch of the Life of D. Humphreys Storer; Samuel Garman, Dr. Storer's Work on Fishes; S. H. Scudder, The Services of Edward Burgess to Natural Science; B. Joy Jeffries, Mr. Burgess's Application of Science in Naval Architecture (illustrated by stereopticon views of yachts and the international races); G. L. Goodale, C. S. Minot, and N. S. Shaler, In Memory of Samuel Dexter.

SCIENCE

NEW YORK, DECEMBER 18, 1891.

ARCTIC WINDS AND POLAR EXPEDITIONS.

Dr. A. Supan discusses, in *Petermann's Mitteilungen*, Bd. xxxvii., No. 8, the movements of the air in the Arctic regions. His results are obtained from a study of Dr. Buchan's charts annexed to the "Challenger" report. Dr. Supan divides the year into three parts: the first extends from November to May; the second from June to August; and the third consists only of the months of September and October. During the first of these a belt of high pressure runs from the Asiatic to the American coast and divides the Arctic basin into two parts. On the east the air flows to the Pacific, and on the west to the Atlantic, low-pressure centre. The middle line of this ridge Dr. Supan calls the Arctic "wind parting" (*Windscheide*). But during the period in question, this wind-parting undergoes great changes in position, approaching the Behring Straits during the months of November and December, and in February beginning a rapid retrogression, which carries it past the Pole and almost to the Atlantic threshold of the Arctic regions. In summer the belt of high pressure disappears, and instead a feebly-developed anticyclone is formed somewhere in the neighborhood of the Pole, whence winds flow outwards towards the continental borders. These winds must, in such high latitudes, be diverted considerably to the east by the rotation of the earth. Lastly, during September and October, a deep barometric depression passes from the Atlantic Ocean along the northern coast of the Old World towards the New Siberia Islands. On the northern edge of this depression easterly winds must prevail. The drift of the "Jeannette," as recorded in DeLong's log-book, is a proof of the correctness of the preceding conclusions, for it must be remembered that the ocean currents are mainly directed by the wind. The vessel advanced or receded, along with the ice in which it was imprisoned, in general, at those times when, according to the foregoing theory, the wind-parting would lie to the east or west of it, respectively. Hence it is evident that vessels entering the Arctic Ocean from the Atlantic have to struggle, for the greater part of the year, against the stream, while those that enter from Behring Straits swim with it. Dr. Supan considers, in the next place, the time that will probably be required by Dr. Nansen's expedition to perform its journey across the Pole. The ice-block which transported the articles belonging to the "Jeannette" expedition covered a distance of 3,300 miles in 1,100 days, or about three miles a day. This is a rate never surpassed by the "Jeannette," except in her last forward drift, and, therefore, it may be assumed that the ice-block did not retrograde so rapidly and for so long a time as the ship. During the changes of the position of the wind-parting it may have always remained in the region of the Atlantic current. It may also be inferred from the drift of the "Jeannette" that the non-periodic displacements of the wind-parting are most marked in the neighborhood of Behring Straits, so that Dr. Nansen is likely to make rapid progress after passing the New Siberia Islands. Five years, then, may be considered as more than ample allowance for the duration of the voyage.

While Dr. Nansen's route is undoubtedly the best for vessels, the Pole may be reached with sledges by other routes. M. H. Ekroll, a Norwegian, has designed sledges, according to the *Scottish Geographical Magazine*, which may be combined to form a boat. His expedition is to consist of six members, and the sledges are to be drawn by a large number of dogs, so that the speed may be increased and the supply of provisions requisite reduced. Being able to travel over sea or ice, the expedition will, to a certain extent, be independent of wind and weather. From the eastern island of Spitzbergen, somewhere about Cape Mohn, to which place the expedition will be conveyed by ship in June, 1893, Herr Ekroll will make for Petermannsland, in order to avoid the ice drifting to the west and north-west. To the north of Petermannsland he hopes to find more compact ice, and to be able to travel direct to the Pole. Should mishap occur, or the movement of the ice be too rapid, he can retreat on Spitzbergen, where a depot will be formed, but, under favorable circumstances, he will return from his furthest point to the east or west coast of Greenland, where also depots will be formed. The success of the expedition depends in great measure on the condition of the ice and the progress that can be made against the wind, for in all probability the wind will be adverse. Dr. Supan estimates the distance from Cape Mohn to Petermannsland at about 435 miles, from Petermannsland to the North Pole at about 590, and thence to Fort Conger at 515. This distance of 1,540 miles would be traversed at the rate assumed by Herr Ekroll, 11 kilometres or about 6.8 miles per day, in 226 days. Herr Ekroll has yet to find funds for his expedition. His country cannot be expected to contribute more to such undertakings, and he will, therefore, have to look for aid elsewhere.

FUNGI INJURIOUS TO FRUITS.[1]

At the close, a thought presses upon me that is the outgrowth of observations in the field, especially during the past two years. Your attention is called to the idea, that healthy plants of strong stock, well-fed and not overworked by undue cropping, are the best able to withstand the inroads of enemies of every sort. There may be exceptions to the rule, but so few, that it can be acted upon with profit. The half-starved plant is no better able to struggle among the vicissitudes of life than the ill-fed and half-sick man. Blights overcome the one as scurvy does the other. Therefore the best conditions for the production of profitable crops are the same as those that will most assist in warding off its fungous enemies. Let the seed, soil, and surroundings be the best and a fungicide, so to speak, has already been used when it will do the most good and render the application of others, when needed, all the more profitable. In short, strive to do the best for the fruit-tree, or shrub as such, and a long step will be taken toward overcoming the enemies that break down the weakest hosts first, because they are weak, and gain thereby strength to overcome the strong. Having done this, we are ready to take up the direct fight of the fun-

[1] From a paper, by Byron D. Halsted, before the Ohio State Horticultural Society.

gous foes with the long end of the lever. It must be a good, promising crop that will warrant the expense of fungicidal applications, and the larger the promise the greater the profit.

One other thought that follows upon this, and the end of this paper is reached. When a house or a community is afflicted with some contagious malady, pains are taken that the germs of the disease shall not remain lurking in out-of-the-way places, and assert themselves in the future. The carpets, and even wall-paper, are removed and the whole house fumigated or otherwise treated with some germ destroyer. While as thorough a cleansing as this is not possible in orchard, vineyard, or garden, there are some measures that could be taken with profit. If weeds are left to mature and scatter their seeds, weeds are expected to follow. In like manner, if all diseased leaves, stems, and fruit are allowed to pass the winter undestroyed, the chances are that the biblical injunction will not be overturned — concerning sowing and reaping. There is a legitimate and therefore profitable amount of soil-sanitation to be done, which comes under the head of cleaning up after crops. The burn-heap is to be a potent factor in future horticulture. If we continue to scatter the seeds of fungus decay, of that sowing we shall reap corruption.

It is a law of plant culture that the continuous growing of any one crop upon a given area of soil, tends to the concentration of the enemies of that crop — whether of insects or fungi. With annual crops, like most of those of the garden and grain field, the remedy is more easily applied, than in the case of fruits. There is a strong inclination to grow the crop for which the soil is naturally best fitted. Thus the onion grower desires to keep his best onion land continuously in onions, and the smut finally increases and ruins his crop and future prospects. Sweet potatoes can be grown to greatest profit only upon a special soil, in limited areas, and constant cropping has permitted the soil-rot to increase to such an extent that the crop is often a failure. The same is true of clover and other crops, but more particularly of those that are susceptible to some root disease. It therefore follows that in the serious consideration of our subject, the importance of a judicious management of crops should never be overlooked, and a system of rotation adopted that will bring the greatest health, other things remaining reasonable and satisfactory.

This continuous change of crops, united with full rations of available plant food, and proper sanitation, will do much to lighten the labors of the fungicidal applications, and render all such when found necessary of the greatest benefit.

Let the spraying of crops with compounds of copper, etc., come after the fair thing has been done for that crop under the head of farm or garden management. Here, as elsewhere, the ounce of prevention is worth a pound of cure, simply because it is prevention, and if we look at fungicides carefully, it will be found that they are preventions, after all.

Do not let me be misunderstood in this matter, for I am a full believer in the virtues of fungicides. There are many places where they pay and pay well, but they cannot do everything. They may ward off destructive diseases, as the copper salts for the black-rot of the grape, but they alone will by no means bring a profitable crop. Everything else needs to be done for the vines that will bring a full fruitage, and then it will pay to save the crop from premature decay. And finally, to carry my point one step further, when the plants have been surrounded by the best sanitary conditions, it is possible that the application of fungicides may be sometimes omitted. However, it will be a long time before all these points are settled, and in the mean time nothing is lost by turning them over in our minds.

ASTRONOMICAL NOTES.

A PLANET of the twelfth magnitude was discovered by Borrelly at Marseilles, France, Nov. 27. The position of the planet was in R.A. 4 h. 6 m. 6.7 s, $\delta + 33° 32' 58''$. The motion was — 1 m. in R.A. and — 7′ in declination.

The following ephemeris will assist those who desire to make a search for Winnecke's periodic comet, mention of which was made in a recent number of *Science*. The epoch of the ephemeris is for Berlin midnight.

1892	R.A. h.	m.	s.	Dec. °	′
Jan. 1	12	17	12	+13	2
2		18	15	13	4
3		19	17	13	7
4		20	18	13	9
5		21	20	13	12
6		22	20	13	15
7		23	20	13	18
8		24	20	13	21
9		25	19	13	25
10		26	17	13	29
11	12	27	15	+13	33

The following is a continuation of the ephemeris for Wolf's comet. The epoch is for Berlin midnight.

1891	R.A. h.	m.	s.	Dec. °	′
Dec. 27	4	14	22	−14	37
29		14	19	14	26
31		14	33	14	16
1892 Jan. 2		14	33	14	5
4		14	51	13	53
6		15	15	13	39
8		15	45	13	25
10	4	16	22	−13	16

An interesting fact connected with the movement of this comet through the heavens, as seen from the earth, is that on the 6th of next February it will occupy almost the same position in the sky that it did on Nov. 12 last. This is also true of Nov 14 and Feb. 8; Nov 16 and Feb. 10. G. A. H.

NOTES AND NEWS.

THE *Pintor* or *Aguaje* is a singular phenomenon observed in the Bay of Callao during the summer months, from December to April. It consists of emanations of sulphuretted hydrogen gas, accompanied by changes in the color of the sea-water. The name "Painter" is given to it because it gives white paint a blackish tinge. Its occurrence is not confined to Callao, but is observed at various points along the coast from Payta (5° 5′ 30″ south latitude) to Pisco (13° 42′ 42″ south latitude), and at Pacasmayo (7° 24′ 30″ south latitude). The gas proceeds from the black mud which covers the bottom of the bay, and the reddish discoloration of the water is due to the presence of infusoria brought in from the open sea. It is not, however, definitely decided why the phenomenon occurs only in the summer and at certain points of the coast. According to Raimondi (*Bull of Amer. Geog. Soc.*, Vol. XXIII., No. 3), the waters of the Rimac are prevented from escaping from the Bay of Callao by the Humboldt current, which flows past the entrance, and, with the solid matter held in suspension, are exposed to the full force of a tropical sun. Where there is no river, or no current running along the coast, the "Painter" is not observed.

— A great deal of misapprehension is often found to exist in the popular mind in regard to matters of eating and drinking; the cause of this to some extent is to be traced to old time sayings, which have come down to us in the form of a concentrated infusion of somebody's opinion upon a subject of which he or she was wofully ignorant. One of these misapprehensions to which we may refer is as to the injuriousness of taking fluid with meals. One frequently hears it laid down as a maxim that "it is bad to drink with your meals, it dilutes the gastric juice." By way of explanation we may remark, says the *Medical Press*, that "it implies that the fluid taken is harmful." Whence this sagacious postulate originally came we cannot tell; it has quite the ring about it of an inconsequent deduction formed by a person whose presumption of knowledge was only exceeded by a lamentable ignorance of the subject. Medical men often find much difficulty in dealing with these museum specimens of antiquated science, for even educated persons are disposed to cling to the absurdities of their youth. Upon this matter Mr. Hutchison remarks in the last number of his *Archives*: "I observe with pleasure that the verdict of general experience and common sense has been confirmed by scientific experiment in the matter of taking fluid with meals. Dr. Tev. O. Stratievsky of St. Petersburg, after elaborate trials, has found that fluids materially assist the assimilation of proteids, and announces the following conclusion, which it is to be hoped no future experiments will controvert — on the whole, the widely-spread custom of taking fluids during or just before one's meals, proves to be rational and fully justified on strict scientific grounds. To take fluids with the meals is almost as important an adjunct to digestion as is the mastication of solid food preparatory to swallowing it. It is obvious, however, that there is a limit to the amount of fluid one can swallow with impunity — not to speak of comfort — just as much with meals as at other times." It would be dangerous to create a general impression that fluid is good with food irrespective of quantity. It is, moreover, a well-ascertained clinical fact that an excess of cumprandial fluid does retard digestion in certain people, and gives rise to discomfort in most. A little attention to one's sensations in such matters will far better fix the desirable limit than all the "data" in the world.

— A meeting of the honorary council of advice in connection with the Crystal Palace Electrical Exhibition, which is to be opened in London on Jan. 1 next, was held recently at the Mansion House. Mr. Gardner, the secretary of the Crystal Palace Company, read the report of the directors, in which they referred to the Electrical Exhibition at the Palace in 1881, and to the enormous strides which had since been made in the industry. The exhibition in 1881 was recognized as the pioneer of electrical engineering in England, and it was confidently believed that the exhibition of 1892 would be remembered in history "as showing that the infant Electra has grown to years of maturity, and is capable of further aiding science, commerce, and the world at large." The space available had been over-applied for, and every section of the industry would be well represented. Invitations would be issued to public bodies throughout the United Kingdom to visit the exhibition, where the various systems of electric lighting would be on view, and in this direction alone very great saving of expense to the authorities would be effected, and other advantages must, the directors believed, also accrue. On the motion of Mr. W. H. Preece, the following gentlemen were appointed to act as a committee of experts in connection with the exhibits: Professors W. Grylls Adams, W. E. Ayrton, W. Crookes, D. E. Hughes, A. B. W. Kennedy, J. Perry, and Silvanus Thompson, Major P. Cardew, Sir J. N. Douglass, Mr. W. B. Esson, Mr. Gisbert Kapp, and Mr. Preece.

— The temperature of the rivers of central Europe has been recently investigated by Herr Forster of the Society of Geographers at Vienna University, says *Nature*; the monthly and annual means being obtained from thirty-one stations. He distinguishes (with reference to river and air temperature) the following types: (*a*) Glacier rivers. These are always warmer than the air in winter, and much cooler in summer; on the average of the year they are about 1° colder. (*b*) Glacier rivers modified by lakes, and rivers from lakes in general. These are, except in the spring, warmer than the air, therefore warmer on the general average. (*c*) Mountain rivers. Like glacier rivers, these are warmer in winter and cooler in summer than the air, but the difference, especially in summer, is not nearly so great; so that, on the average of the year, it is approximately 0°. (*d*) Flat country rivers. Their temperature is, throughout the year, higher than that of the air; and the annual average difference is over 1°. Sometimes a different relation between river and air temperature is found in the upper part of a river and in the lower, and transition-types occur between those above indicated.

— A new system of wood-paving that is now being tried in Paris makes use of pieces of oak about four inches long, split up similarly to ordinary kindling-wood. The sticks are laid loosely on end in fine sand on a bed of gravel from four to four and one-half inches thick. A layer of fine sand is spread over them, and they are alternately watered and beaten several times. In about forty-eight hours the water has completely penetrated the wood causing it to swell into a compact mass, which is capable of supporting the heaviest traffic, according to reports.

— Elderly persons tell surprising stories of the old-time fear of giving cold water to fever patients. This has long since passed, and they now are permitted to drink freely. Still further than this, starting principally from the theoretical consideration that the poisonous products of the action of disease-producing bacteria in the infectious diseases may be got rid of by washing them out, a few physicians have tried the administration of drinks in very great quantities,— much more than the patients would voluntarily call for. For instance, Dr. Valentini of Königsberg (Deutsche Med. Woch., xvii, 914) directs the nurses to give the typhoid-fever patients milk, bouillon, and water in quantities that would appear impracticable if mentioned. In addition to it all he has latterly given 200 grams of sugar of milk dissolved in a litre of water as a food and to increase the diuretic effect. The results, we are told, are surprising. The concentrated renal secretion is diluted and increased and, even at the acme of the disease, its quantity is maintained at much above what is usual in fever. In milder cases the diuresis is kept somewhat above the normal. The patients were more comfortable than before the beginning of the treatment, and all the cases terminated favorably.

— Dr. Ermling contributes to a recent number of *Globus* an interesting paper on the Nurhagi of Sardinia. There are said to be more than 3,000 of these prehistoric buildings in the island. They are almost all in fertile districts, and are built in groups which are separated from one another by wide and generally barren spaces. According to many archæologists, the Nurhagi were tombs; but the late Canon Spano, in his "Memoria sopra i Nurhagi di Sardegna," published in 1854, contended that they were dwellings and places of refuge, and this view is accepted by Dr. Ermling. In a trench closed with asphalt, under the ruins of a Nurhage near Teti, various bronze statuettes, swords, spear-heads, and axes were discovered lately by shepherds. These treasures, according to *Nature*, are now in the museum of M. Gouin, a Frenchman, in Cagliari. Some of the objects have been analyzed, and it has been found that the chemical composition of the bronze statuettes is not the same as that of the axes. The statuettes consist of copper 90.3, tin 7.4, iron 2.1; the axes, of copper 87.4, tin 12.0, lead 0.5, with traces of iron.

— Mr. James Shaw writes to *Nature* as follows: "I labor under the peculiar inconvenience of having a right eye of normal power and a short-sighted left eye. The numerals on the face of a clock five-eighths of an inch high are visible to the right eye at twelve feet distant; but in order to discern them as clearly with my left eye I require to bring that organ of vision as near to the figures as eight inches. On looking at my gold chain hanging on my breast in daylight and with both eyes, the chain colored yellow and towards the left, is perceived by the right eye, while a steely blue chain, another, yet the same, is perceived about an inch to the right and a little higher up. By artificial light the same phenomenon presents itself, but the difference of color is not so apparent; the yellow to the right is only dimmer. Again, when a page of *Nature* is being read with the short-sighted eye, there appears, about an inch to the left, part of the same column, small, and the black, under artificial light, like weak purple. The right-hand side of this ghost-like column is lost to the right eye, being commingled with the larger, darker letters seen by the short-sighted left, which cover it like the more recent writing on a palimpsest. Middle life was reached before the discovery was made. These experiences must be gone through with intent, for objects generally being perceived altogether with the right eye, all that the left seems good for is to supply a little more light. The perception of the difference of color is as good with the one eye as the other, and the short-sighted eye can read smaller type. As the inferior animals, so far as I know, have no habit of peeping or looking with one eye shut and the other open, it occurred to me that this ability might be a limited one. I tried the experiment with school children, and to my surprise found that a few were quite unable to keep one eye shut and the other open at the same time, and a few did it with an effort, making in all about a fourth of the number. Adults were likewise under similar limits, but to a less extent. This may be the reason why the discovery of inequality of vision, as Sir John Herschel remarks, is often made late in life. Indeed, he mentions an elderly person who made the unpleasant discovery that he was altogether blind of an eye."

— The University Extension Conference in Toronto, on Nov. 5–6, led to the establishment of the Canadian Society for the Extension of University Teaching, the organization of which is largely modelled on that of the American Society. The Universities of Ontario and Quebec were thoroughly represented and the leading colleges, normal schools, and high schools of the Dominion sent delegates. President James of the American Society gave the leading address on the evening of Nov. 5, and was present at the different sessions to explain the various questions that arose. The presidents of the new society are Sir Donald A. Smith of Montreal, Chancellor G. W. Allen of Trinity, Chancellor Edward Lake of Toronto University, Professor Goldwin Smith, Chancellor Sanford Fleming of Queen's, and Abbé Laflamme of Laval University. The secretary is Mr. William Houston of Toronto, the well-known economist, to whom is due in large measure the success of the meeting and the establishment of the society.

— The following is an abstract of a bulletin on "The Hessian Fly," recently published by Professor F. M. Webster, consulting entomologist to the Ohio experiment station. This fly is a small, dark-colored, two-winged fly, about one-eighth of an inch long and shaped much like the wheat midge, both belonging to the same order and family of insects. The male is more slender than the female, which, when full of eggs, slightly resembles a diminutive mosquito moderately full of blood. The life of the insect in the adult stage is short, the male dying soon after pairing and the female soon after oviposition. The egg is about one-fiftieth of an inch long, of a dull reddish color. The larva or maggot is, when first hatched, of a nearly white color, with a tinge of red, but later they are very light green, clouded with white. The pupa is formed under cover of the puparium, which last is known as the "flaxseed" stage, on account of its resemblance to a flaxseed in form and color. The insect is best known under this name and in this stage of development. The eggs are deposited by the female very soon after she hatches from the "flaxseed," as the rule, on the upper side of the leaf. This task is finished in a few days, after which she dies. The young hatching from the egg works its way downward, beneath the sheath to its base. In the fall this is just above the roots below ground, but in spring they do not go below ground, as a rule, but stop at or near one of the lower joints. It is proper to say that this pest suffers much from the attacks of several minute parasites, which attack and destroy it in both the egg and larval or maggot stage. There are two annual attacks of the Hessian fly, one appearing in the fall and the other in the spring. With the fall brood the time of depositing the eggs varies with the latitude, the farther north the locality the earlier the time of egg laying. In northern Ohio the eggs are deposited early in September, while in the southern part this is delayed until probably early in October, the grain over the territory between these points being stocked with eggs between the dates given. Whether there is the same variation with respect to the spring brood is not known. The eggs at this season are deposited in April and May, the insect usually reaching the "flaxseed" stage before harvest and remaining through July and August in the stubble. The preventive measures may be noticed as follows: Sowing at the proper time; burning of the stubble; rotation of crops; sowing long, narrow plats in late summer as baits; applying quick-acting fertilizers to seriously infested fields in the fall in order to encourage attacked plants to throw up fresh tillers, and to increase the vigor of these that they may make sufficient growth to withstand the winter. After the fly has gained possession of a field Professor Webster knows of no application that can be made which will destroy it. Doubtless pasturing the field, if early sown, will often result in reducing the numbers of the pest, besides giving to the ground that compact, pulverized nature which it should have had at first. No doubt many larvæ and "flaxseeds" by this means would be crushed, but very few would enter into the food of the animals grazing thoreon, unless the plants were pulled up both stem and roots. Sheep are probably the best animals to turn on wheat as they are not heavy enough to injure plants by trampling.

— The work of university extension has been undertaken in Australia by the University of Melbourne. There are at present nineteen lecturers on the list whose courses include a wide range of subjects in the departments of history, literature, art, philosophy, and science. It is claimed that while the work will suffer under certain disadvantages as compared with England, the rural population being scantier and less compact, and the means of communication not so good, the average Victorian has greater means and more leisure at his disposal than the average Englishman. Certainly the Australians are not a people lacking either in energy or in quickness to avail themselves of whatever advantages may come within their reach. It is interesting to note another illustration of the analogy between Australian and American development in the adoption of the short course of six lectures. With the success of the work, however, the tendency to longer courses will certainly appear in Australia as it has already done in the United States.

— On Dec. 2, Mr. G. H. Robertson read before the London Society of Arts a paper on "Secondary," or, as he prefers to call them, "Reversible Batteries," which is reported in *Engineering*. After giving the history of their invention and improvement, he reviewed the chemical changes which take place in the acid, this being a subject to which he has devoted very great attention. Planté considered that the variations in electromotive force were due to the formation of peroxides in the acid. Messrs. Gladstone and Tribe, testing the acid between the plates, always found traces of something which decolorized permanganate, and might therefore be hydrogen dioxide or ozone. In 1878 Berthelot discovered persulphuric acid ($H_2S_2O_8$), and showed it was the primary product of the electrolysis of sulphuric acid solution, and that the hydrogen dioxide present in sulphuric acid after electrolysis is due to the action of that body on the acid. Persulphuric acid begins to decompose as soon as the current is stopped, and its decomposition is accompanied by the formation of hydrogen dioxide, unless the acid is too dilute. Mr. Robertson found that when cells were tested they contained active oxygen, due to the presence of persulphuric acid and peroxide of hydrogen in varying proportions. During charge persulphuric acid is the main constituent; during discharge the quantity of hydrogen dioxide gradually increases; while in a cell that has been at rest some time there is very little except hydrogen dioxide to be found. Active oxygen forms at once on the passage of the current, decreases slightly, and then increases to a little above its first value. Starting either charge or discharge always causes initial increase, except in the case of cells which have been long idle, when there is a diminution due to the decomposition of the excess of hydrogen dioxide in the acid. Persulphuric acid does not itself reduce peroxide of lead, but it forms hydrogen dioxide on standing, and this is capable either of oxidizing the lead plate to litharge, or of reducing the peroxide plate to the same substance. In each case the litharge is converted into sulphate by the sulphuric acid. This appears to explain the well-known deleterious effect of rest on a cell. In an ordinary good cell of 45 pints capacity there is sufficient active oxygen to convert 3.25 to 7.5 grammes of peroxide of lead into sulphate, or to undo the work of one or two ampère-hours charge. At each reversal, however, the peroxides are broken up, but if the cells stand idle the plates get sulphated, and the amount of active oxygen formed in the next passage of the current shows a marked increase. In sodium sulphate cells the active oxygen is usually less than in plain cells and the hydrogen dioxide always so. The variations in electromotive force appear to depend on which plate hydrogen dioxide is formed at. When present at the peroxide plate it causes a rise, but when diffused through the acid and present at the lead plate it causes a lowering.

— At the Methodist Chinese Mission, 205 West 14th Street, New York, a writer in *Our Language* for December states that he witnessed on Nov. 8 a demonstration of the value of phonetic spelling as a stepping stone in teaching pupils to read ordinary English. A pupil of the school, who had received five lessons a week for three weeks, was examined and found able to read seventy-four pages of "Harper's First Reader." He had been taught by Mr. Knoflach, using "Sound-English" at first, and passing from this into the ordinary print. The Chinaman's mission teacher stated that her pupil could neither read nor speak English, except three or four short phrases, when Mr. Knoflach took him in hand, and she, together with several of the other teachers, expressed much wonder and delight at the achievement. The man also read the first eight chapters of Genesis. The teaching is especially difficult in such a case as this, for the pupil cannot understand the instructor's explanations; besides, several sounds in English are strange to Chinese vocal organs. Mr. Knoflach has since begun to teach German and Italian children to read English by the same means, in a New York charity school.

— Nossilof, who has devoted so much time to the exploration of Nova Zembla, spent last winter at the western entrance of Mathew Strait, in a house specially constructed after his own plans and brought from Archangel. Up to November M. Nossilof was able to make excursions into the Kara Sea, collecting birds and animals, surveying the coast, and taking soundings in the sea. The winter was unusually stormy, and the sea remained open until spring. Torrents of rain fell, so that the country was covered with a coating of ice, and the reindeer perished from hunger; hundreds of seals were frozen on the ice, and fish were thrown up in heaps on the shore. Changes of temperature occurred with great suddenness: from $-31°$ F. the thermometer rose to $+37°$ F. in a few hours. The spring and summer were correspondingly severe, and the temperature did not rise above 41° F. up to the end of July. Nevertheless, the scientific work of the expedition was carried on without interruption, and large zoological collections were made (*Scottish Geographical Magazine*, December). This is the third winter M. Nossilof has spent in Nova Zembla. His next journey will be to the peninsula of Yalmal.

— The *Abhandlungen* of the Royal Prussian Meteorological Institute (Bd i., No. 4, 1891) contain the first part of a treatise on the climate of Berlin, referring to rainfall and thunderstorms. Berlin possesses a long series of observations, commencing with the beginning of the eighteenth century, but in this investigation some of the earlier observations have not been used. The subjects treated, as we learn from *Nature*, are: (1) The amount of rainfall, the annual mean being given as 23 inches. The extreme values varied from 14.26 inches in 1887 to 30 inches in 1882. The wettest months were June and July, yielding together 24 per cent of the annual amount. (2) Rain frequency. The average number of days on which 0.08 of an inch fell was 152. The months of greatest rainfall frequency were November and December. (3) Hail and soft hail (*Graupel*). The former occurred on 2 to 3 days and the latter on 3 to 4 days in each year, and mostly in the months of May, June, and July. (4) Snow. A Berlin winter numbers on an average 33 snowy days. The distribution according to months is very curious: snow does not occur most frequently in the coldest months; it falls as often in March as in December. It lies on the ground 49 days on an average. (5) Intensity of rainfall. Daily falls of more than 2 inches are quite exceptional, and of 1½ inches are not frequent. The greatest fall was 1.86 inches in 1½ hours. (6) Wet and dry periods. Attention is more particularly given to periods of short duration; wet periods of five or more days are fewer than dry periods of similar length; the former average 7.5 and the latter 13.2 per year. (7) Thunderstorms. Berlin enjoys comparative immunity from thunderstorms, as they occur on an average only 15 days in the year, about half of them being in June and July. This valuable discussion has been carried out by Professor G. Hellmann.

— The external part of the laboratory which is being built in the Paris Museum of Natural History for Professor Chauveau, from the designs provided by him, is now finished. This laboratory will be used only for original research in physiology and bacteriology, and when completed will be the finest laboratory in France. But the Museum, according to *Nature*, is deeply in debt, and this may cause some delay.

— At the late International Congress of Hygiene and Demography, in Section 4, which was concerned with the Hygiene of Infancy and School-life, a resolution was passed in favor of the teaching of upright penmanship or vertical writing, on the ground that spinal curvature and short sight are caused by the faulty position of the youthful student, which is necessitated by slope of the letters. We can all of us remember, says *Lancet*, the trouble of learning to write, and the mental and physical toil which the making of our first pothooks and hangers involved. The number of muscles put in action when a person is writing is prodigious, and it is probable that in beginners every muscle of the body must yield its assent before the graphic symbols trickle from the pen. The fingers, wrist, elbow, and shoulder must all be held steady. The spine must be rigid and fixed below as well as above. The pelvis must be firm, and to this end the child often gets a support by its feet from the legs of the chair. The thorax is more or less rigid, and its movements are determined more by the work of the hand than the respiratory needs. Lastly, the knit brows and protruding tongue are unconscious muscular acts which serve to mark the effort, both of body and mind, which the child undergoes when learning to write. It is notorious that in writing our individuality asserts itself in spite of the pedagogue. We are taught certain rules for sitting at the desk and holding the pen, which we ultimately learn to neglect, and finally write in a fashion of our own. The great drawback of writing as an exercise for children is the fact that it involves one-half of the body only, and the necessity of fixing the spinal column causes the child instinctively to loll upon its left side while the right arm is working. To what extent the asymmetry of posture is caused by the fashion of sloping the letters it would be difficult to say, but there can be no doubt that the writing master ought to carefully watch the attitude of the child and endeavor to make it sit square to the desk and maintain the spinal column vertical. Every child should have a foot-stool to give firm support to the feet, and the seat should not be slippery, so that the fixation of the pelvis may be easy. Vertical writing is very legible, and if it diminishes to any extent the tendency to sit "lop sided," it ought to be encouraged. The true remedy for the evils produced by learning to write seems to us to be to teach the child to use both hands, and to practise alternately with either hand. Vertical writing lends itself more readily to ambi-dexterity than does sloping writing, and there can be no doubt that a clerk who could write with equal facility with either hand, and could rest one side of the body while the other was working, would be little liable to writer's cramp and similar troubles. Seeing how enormous is the muscular effort involved in giving the hand sufficient steadiness, and that the brain fag is scarcely less than the muscle fag, it goes without saying that writing lessons should at first be of very short duration. Ten minutes with each hand ought to amply suffice.

— Mr. P. H. Rolfs, recently connected with the Iowa Agricultural College, Ames, Ia., has been appointed botanist and entomologist of the Florida Agricultural Experiment Station at Lake City, Fla.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The Exchange" column is likewise open.

MASTODON REMAINS ON NEW YORK ISLAND.

ON Nov. 27 last Lieut.-Col. Gillespie of the Engineers' Department, U.S.A., addressed a letter to the American Museum of Natural History, offering the remains of a mastodon tusk which had been found during the excavation for the Harlem Ship Canal at the upper end of New York Island. Col. Gillespie informs me that the specimen was found at a depth of sixteen feet below mean low-water, at the eastern end of Dyckman's Creek, at its junction with the Harlem River.

The portion of the tusk preserved and received at the museum is nearly three feet long, and has a diameter of seven and a half inches full, at its largest part; being the upper or socket end of the tusk, and is well preserved, although much shattered by drying and rough handling by the workmen before it came to the attention of the engineers in charge of the work.

A few days after the tusk was received at the museum I visited the excavation, and, by the courtesy of the engineers in charge, Messrs. A. Doerflinger and J. McC. Taylor, learned the particulars of its occurrence.

The excavation at this point is through the salt meadow of the Harlem River, showing from four to six feet of meadow sod and silt filled with the roots of the meadow grass; below this there is a deep bed of incipient peat, of which, at the spot where the tusk was found, there was fully twelve feet; next below comes a bed of sandy clay of very variable thickness, but at the spot in question measuring only eighteen or twenty inches in thickness. This clay rests immediately on the submerged slope of the dolomitic limestone ridge which forms the upper end of Manhattan Island, and extends northward beyond the Spuyten Duyvil Creek.

The tusk was found imbedded in the peat with the socket or "butt" end down, and slightly entering the sand, the shaft being in the peat and at an angle of about seventy degrees to the horizontal, showing that it had settled through the peat until it came in contact with the sand.

From the indications furnished by the conditions of its occurrence I should conclude that the tusk had not been transported from any other locality after the death of the animal, as there is no abrasion shown on its surface. Moreover, the peat in which it was imbedded is in the condition of its original formation, is clean and unmixed with any foreign matter, being entirely of vegetable origin; and contains quantities of seeds, apparently of Carices, or sedges, and grasses, as well as a few nutlets of some bush or shrub not yet determined, and examples of the elytra of beetles. At the top of the peat occur numbers of the stumps and roots of forest trees and fragments of wood. No evidence whatever is found of any marine substance below the roots of marsh grass, not a vestige of any kind of mollusks, marine or fresh water, can be detected, although now living and abundant in the salt water at the surface. The sandy clay between the peat and the surface of the limestone appears to me to be the result, principally, of the decomposition of the limestone in place, and not transported sand. Glacial markings are discoverable on the surface of the limestone a short distance south of the locality, where the soil has protected it from the action of the weather, but where the ledge has been uncovered by the removal of the peat and sand, it shows a deeply rotted surface covered by the sand.

Dyckman's Creek was an artificially excavated channel, made about 1818, for the purposes of a tide mill, through a natural depression at that point, and not a natural stream; consequently, it could have had no agency in the transportation of the tusk; and it seems probable that the animal to which the tusk once belonged either died near the spot, or by some accidental injury had it broken from its socket near where it was found.

The exact location of its occurrence is in the canal, about fifteen feet from its northern side, and about ten feet west of the centre of Broadway.

In April, 1885, Elisha A. Howland, then principal of grammar school No. 68, at 128th Street, between 6th and 7th Avenues, brought and donated to the museum the lower extremity of a mastodon tusk, nearly fifteen inches long by four in its greatest diameter, which had been found shortly before at Inwood, N.Y., while cutting a ditch through a peat bed near the Presbyterian Church at that place. This fragment shows fresh breaking at the upper end, and was undoubtedly much longer when first found.

R. P. W.

CO-OPERATIVE OBSERVATION OF THE SO-CALLED LUMINOUS CLOUDS.[1]

SINCE 1885 curious cloud formations have been seen on summer nights in both the northern and southern hemispheres, in evident connection with those phenomena which followed the great volcanic eruption at Krakatoa. The intense brightness of these formations, considering the position of the sun, denoted that they were situated very far above the earth's surface. Probably these clouds consisted of erupted particles thrown to a very great height and there illuminated on summer nights by the sun.

These cloud-like formations, commonly called luminous clouds are extremely interesting, both on account of the extraordinary height at which they have for years been moving above the surface of the earth (more than eighty kilometres) and of the movements themselves. A very important point about these clouds is that they are — so far as we yet know — visible in each hemisphere only in the summer. It is the more important that these phenomena should be carefully

[1] From Nature, Dec. 3.

and widely observed, since it is believed that they are gradually breaking up, so that probably in a very few years no distinct traces of them may remain (see also O. Jesse on so-called luminous clouds, in the journal *Himmel und Erde*, vol. i., p. 263).

Photographic results of the researches of O. Jesse are given in Part xl. of the Transactions of the Berlin Academy of Science for 1890, and Part xxvi. for 1891. It is very desirable that such photographs should be taken in as many different localities as possible, because from them we get the surest basis for consideration of the situation and movements of the clouds. But valuable aid may be given by the co-operation of numerous observers in various regions of the earth without the aid of any apparatus.

The principal points upon which stress is to be laid in this inquiry are: —

(1) By what method can the so-called luminous clouds be most surely distinguished from others, especially from the ordinary cirrus cloud?

Clouds or cloud like formations which after sunset and before sunrise stand out brightly from the dark ground of the heavens, no earthly or unearthly sources of light being present on the horizon, can only produce this effect by means of their own light or else by light which they receive directly or indirectly from the sun or moon below the horizon.

Cloud-like formations which shine at night by their own light have doubtless been formerly observed above the surface of the earth. To these formations belong not only thunder and lightning clouds, but also some polar light and meteoric phenomena.

But the so-called luminous clouds do not belong to the various species of self-luminous clouds, for finer measurements of their light are wanting, besides which the fact that they are only seen within the zone of twilight proves that the sun below the horizon is the principal source of their light.

It is well known that there are clouds within this twilight zone which resemble high mountain peaks, and which in the first stages of twilight shine in the light of the sun, though the latter is below the horizon of the observer. It is easy to determine the relation between the position of the sun below the horizon, and the height of those layers of atmosphere which receive the sun's light and reflect it.

But the laws which govern the whole course of twilight are modified when the distribution of the sunlight-reflecting particles in the atmosphere is altered to any great extent. If, for instance, numerous minute atoms produced by volcanic eruption or by the breaking-up of meteoric bodies find their way into those heights above the earth's surface in which usually the gaseous elements of the atmosphere are present in a very scattered form, it may happen that such a layer, which reflects the sunlight very strongly, may curiously alter the course of the twilight.

So long after sunset as the masses of air beneath such a layer receive direct light from the sun and reflect it, the observer will not distinguish any deviation from the usual course of twilight. But as soon as the further sinking of the setting sun gradually deprives the lower layers of air of the direct light, the higher layer of dust still receiving light from the sun stands out in astonishing brightness, the particles of dust having strong reflecting power, thus giving to the close of twilight the curious effect of the sudden appearance of shining clouds on the broad surface of the heavens.

The phenomena of the luminous clouds corresponded when first perceived to the above description. At present they are no longer so strong or so extensive, but only form thin whitish-blue shining veils, similar in form to the so-called cirrus or feather-clouds, occupying but a comparatively small part of the floor of the heavens inside the twilight segment, and in our zone mostly near the horizon. Probably, the layers are now so thin that very near and exactly above us they can no longer be seen.

From the above considerations, it is clear in what way these clouds differ from those situated nearer to us, and especially from the cirrus clouds floating scarcely more than thirteen kilometres above the earth's surface. All these lower clouds appear in the later twilight gray and shadowy on a light ground, because the layers of atmosphere above them are the chief source of the remaining twilight. The luminous clouds differ too in shape and structure from the other kinds of clouds.

We must guard, however, against the error of mistaking cirrus for luminous clouds, when, in exceptional cases, the former look very bright, in consequence of receiving light either directly or indirectly from the moon or other sources. In this case, the question is decided by the relatively high degree of stability in position and form of the very high and distant luminous clouds, as ordinary clouds lie lower and nearer, and show much more rapid changes of position.

(2) When convinced of beholding so called luminous clouds, to what points shall attention be especially directed, and what simple measurements of place, time, form, etc., shall be carried out in order to aid most usefully in the inquiry?

In answering this question, we will first consider those methods of research in which the observer can obtain no instrumental aid, except only a watch, which should be a sufficiently good timekeeper to estimate the time of observation to one minute, when compared with the correct time within eight or twelve hours after the observation.

Such simple observations are the more useful, since it frequently happens that in the well-fitted up and prepared stations, observation of the phenomena is prevented by bad weather, or else that the phenomena stretch over too large an extent of the earth's surface to be included in an organized series of observations. The farther the stations are apart, the more valuable are the most simple methods. For instance, in order to get corresponding photographic observations from two stations, thirty-five kilometres apart, such as Berlin and Nauen, the most rigid exactness, both as to time and place, must be observed.

If, however, observations are taken in East Prussia and in the Rhine province respectively, a from twenty to thirty times larger margin of difference as to time and place can be allowed than in the foregoing case, without in any way lessening the value of the result.

So, if without preparation and instruments to hand an observer believes he beholds luminous clouds, he must not imagine that he can render no service to science by examining them closely, for very possibly the most simple method may, taken in conjunction with other similar observations, prove to be of the greatest service.

It is desirable, too, to look out for luminous clouds at all seasons of the year, though, so far, they have only been seen in summer. In the northern hemisphere they have only been seen from the end of May to the beginning of August, with greatest frequency and brightness in the month of July.

During these weeks, usually two stars are seen simultaneously with the luminous clouds, a star of the first magnitude, Capella, and a star of the same constellation, of the second magnitude, β Aurigæ.

The brighter of the two stars, which is characteristic of summer nights, in the northern horizon, sets towards the end of June soon after eleven, and towards the middle of July before ten, on account of the northerly direction of the meridian, and, in North Germany, at a distance from the horizon of ten to twelve diameters of the full moon. At almost as great a distance from this bright star, and at a not very different distance from the horizon, the second magnitude star follows towards the west.

By estimating the distances and directions of these two stars, an excellent means is afforded of determining the outlines of a group of luminous clouds. It is only necessary to determine how great the distance of a certain part of the outline of the cloud group is from one or the other star, and in what direction this line lies with regard to one or the other star, or how far the line in question is above or below the prolongation of the connecting line of the two stars. A simple drawing of the course of the outlines and their situation with regard to the two stars is useful, even when it cannot be completed on the spot but must be finished from memory. The time at which the drawing was made should be noted within one half-minute.

If the group of clouds should be so far from the above-mentioned two stars as to make the determinations inexact, it is advisable to determine the outlines of the clouds for a certain time in the following way. Take up a position from which the outlines of houses, trees, etc., can be seen close to the position of the clouds, and fix thus the relative position of these earthly objects to the position of the clouds by a simple drawing, describing the spot from which the observation is made in such a manner that the place occupied by the head of the observer can be found again. The lines drawn from the position of the observer to the outlines of the earthly objects, and the resulting localization of the outline of the clouds in the heavens can then be determined at once by means of simple instruments for measuring angles, or on succeeding nights by the aid of a good star chart.

It is necessary to verify the exact point of time of these observations by comparison of the watch used with the time at a telegraph office, and correction of any errors should be made to the fraction of a minute.

In communicating these observations, the exact place at which they have been made must be accurately described.

Should a complete observation be impossible, owing to the time during which the luminous clouds are visible being too short for careful measurements and drawings or to any other cause, the observer should nevertheless communicate briefly to the Society of Friends of Astronomy and Cosmic Physics that he has seen what he believes from the foregoing considerations to be luminous clouds from a certain place, in a certain direction in the heavens, and within a certain quarter-hour.

The peculiar movements hitherto observed of the clouds in question lead to the suggestion that perhaps a period consisting of several days exists, within which one and the same group of clouds is visible at the same hour from the same place, other conditions of the heavens being favorable. Every communication as to these phenomena will be valuable in the decision of this important point, which it has hitherto been impossible to settle, owing to the uncertainty of the weather and the fewness of the observers.

Those co-operating in our branch of research who are in possession of astronomical, photographic, or other physical apparatus, will of course be able to give more exact details as to place, movement, and continuation of the luminous clouds.

Suggestions for these observations cannot be given so briefly and simply; but for the sake of full and complete agreement between different observers, especially as to the point of time selected for taking photographs and measurements, members of the Society of Astronomy and Cosmic Physics are invited to communicate with O. Jesse, Steglitz bei Berlin, Albrechtsstrasse 30. This course would also be advisable in the close optical examination of the clouds with regard to the peculiar changes in strength of light and the degree and kind of self-luminosity which they perhaps send out together with the reflected sunlight.

In the night from June 25-26 of this year the summer re-appearance of the luminous clouds was observed very brightly from Berlin and the neighborhood.

More detailed particulars on the whole subject of inquiry are contained in a small paper by W. Foerster, which has been sent to all the members of the Society of Friends of Astronomy and Cosmic Physics.

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.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

A Bowlder of Copper and Glacial Striæ in Central Missouri

A FEW weeks ago there was found near this place a small bowlder, or nugget, of copper, weighing twenty-three pounds. It is eleven inches long, six inches wide, and three inches thick at thickest part. It is almost entirely pure copper, but with a thin crust of the green carbonate all over it except at one end, where there is a slight depression, two inches wide, in which there is a thicker coat — somewhat crystalline — of the blue carbonate. In some crevices in it I found fragments of a coarse red sandstone.

This is a region of impure limestone and shale, of the coal measures, with no trace of copper. But all over the surface of the country in this vicinity pebbles and small bowlders (sometimes two or three feet thick) of granite, quartzite, etc., are found.

In at least one locality near here there are glacial(?) striæ upon the surface rocks. These are on the top of a bluff on the Missouri River and about twelve miles south-west of the place where the copper was found. The top of this bluff is at least a hundred and fifty feet above the present level of the river. Its upper layer of rock is of Burlington limestone, which is polished and much marked with striæ. These striæ are north and south in direction — nearly parallel with the river at that point.

Taking all these things together, I think my piece of copper is from the Lake Superior region and was brought here by a glacier. A geologist of note, to whom I reported the find, says, "It is undoubtedly of glacial origin, and probably from Michigan."

While thoroughly satisfied that this piece of copper is of glacial origin, I am not so decided in the opinion that the striæ referred to were made by a glacier rather than by floating ice for the following reasons:

The place where the striæ are found is at the summit of an anticline which can be plainly traced in the exposed edges of the bluffs for several miles. Standing on the summit of this anticline, and looking across the river, you can see, about two miles distant, the continuation of the same anticlinal ridge. This also presents a bluff towards the river. Between the two bluffs is the flat bottom land along the river and the river itself. Now it seems likely that this anticline was lifted up late in time, and may have temporarily dammed or obstructed the flow of the river — then much larger than now. Or an ice gorge in the river at this point may have been the obstruction. At that time the water, filled with floating ice, may have made the striæ as it flowed over the top of this dam; until finally it cut a chasm through the obstruction.

Another fact suggesting the same probability is that from this anticline for many miles up the river there are considerable Loess deposits. These may have been made before the obstruction was was cut through.

But while the striæ at this place might be thus accounted for, this would give no sufficient explanation of the presence of the bowlders, etc., scattered over these hills many miles from the river and several hundred feet above its bed. In fact there are now three or four feet of clay or soil overlaying the very rocks which have the supposed glacial scratches on them, and this clay, etc., has in it pebbles and small bowlders of the same kind as those scattered over the surface of this section.

So, upon the whole, I think bowlders, striæ, and all are of true glacial origin. J. W. KIRKPATRICK.

Fayette, Mo., Dec. 9.

Mexican Featherwork.

"THE most famous surviving specimen is the *standard*, described by Hochstetter, which is now in the Vienna Ethnographical Museum" (*Science*, Dec. 4, p. 311, 2d col., top). This splendid piece of old Mexican featherwork is the subject of special publications by Mrs. Julia Nuttall, entitled "Das Prachtstück altmexicanischer Federarbeit aus der Zeit Montezuma's im Wiener Museum" (Reports of the Dresden Museum, 1887), and "Standard or Head-dress" (Archæol. and Ethnol. Papers, Peabody Mus., Harvard, 1888, Vol. I., No. 1). Both these papers are elaborately illustrated and bring forward overwhelming evidence to show that what has hitherto been considered an Aztec standard is really a head decoration. X.

Kansas Mosasaurs.

HITHERTO, no adequate description or figure has ever been published of the complete anatomy, or even of the skull, of any member of the extinct group of reptiles known as the Mosasaurs or Pythonomorpha. Fortunately, however, my able friend Dr. Baur has recently had the opportunity to thoroughly study an excellent specimen of one of the Kansas forms, and his figures and descriptions, when published, will doubtless be of great interest. The University of Kansas has, within recent years, obtained one of the most valuable collections of these animals now extant. Among this material, there is one specimen of especial interest, by reason of its remarkable completeness, consisting, as it does, of skull and connected vertebræ to the tip of the tail, with ribs, extremities, and cartilages in position.

Before briefly describing this specimen, which belongs to a different genus from that studied by Dr. Baur, I may be permitted to offer the following remarks upon the nomenclature of the Kansas forms, based upon larger opportunities than have been enjoyed, I believe, by any other investigator.

The following generic names have been proposed or adopted by various writers for the different forms of these reptiles from the Kansas Cretaceous: *Liodon* Owen, *Platecarpus* Cope, *Clidastes* Cope, *Sironectes* Cope, *Lestosaurus* Marsh, *Tylosaurus* Marsh, *Edestosaurus* Marsh, and *Holosaurus* Marsh. Three genera, only, can be readily and positively distinguished among the material. The names now recognized for these, and with justice, are: *Liodon*, *Platecarpus*, and *Clidastes*. Two others, *Sironectes* and *Holosaurus*, have, possibly some claims for recognition, but the evidence in favor of either is, so far, very weak. *Holosaurus* is not synonymous with *Sironectes*, as affirmed by Cope and followed by Dollo. *Holosaurus* rests almost solely upon a single character, the non-emarginate coracoid; in other respects nothing is known to separate it from *Platecarpus*. In fact, *Platecarpus* itself may possess this very character. That the character was not considered by the author of *Holosaurus* as important is evidenced by the following. In the *American Journal of Science* (Vol. iii., June, 1872, p. 5 of separate) he says: "There is certainly no emargination in the coracoid of *Clidastes*, *Edestosaurus*, and *Baptosaurus*, as specimens in the Yale Museum conclusively prove." A figure of the coracoid of *Clidastes* (*Edestosaurus*) *dispar*, given in the same paper, shows the bone entire. In the same paper in which *Holosaurus* is figured and described (*Amer. Jour. Sci.*, vol. xix., pp. 83–87) a restoration is given of the shoulder girdle of "*Edestosaurus dispar* Marsh," in which the coracoid is very conspicuously seen to be emarginate. That this was not an error on the part of the artist, I can vouch, for the specimen from which the figure was made was collected and restored by myself. There is a lack of consistency here somewhere.

A fuller discussion of the genera and generic characters of the Kansas material, I leave to a future occasion. As there have been more than twice too many generic names given; so, too, it is pretty evident that there is even a greater proportion of synonyms among the specific names. The specific nomenclature is, at present, however, a subject of great intricacy, of which no one is master. Mr. E. C. Case of the State University will shortly publish a paper on this subject.

With these general observations, I will now give a brief description of the specimen above mentioned; a fuller description, with illustrations, will appear later. The specimen is a *Clidastes* (*Edestosaurus*) and, from Mr. Case's studies, probably *C. velox* Marsh, which is apparently the same as the earlier described *C. cineriarum* Cope. The specimen measures, from the tip of the tail to the tip of the rostrum, one hundred and thirty-nine and one-half inches, including altogether one hundred and seventeen vertebræ, the whole regionally divided as follows: skull, seventeen and one-half inches; cervical region, seven vertebræ, eight and one-half inches; costifarous, post-cervical region, thirty-four vertebræ, fifty-four and one-half inches; non-rib or chevron-bearing region, seven vertebræ, eight and one half inches; chevron bearing region, sixty-eight vertebræ, fifty-one and one half inches. All of the cervical vertebræ, save the atlas, have ribs, those of the axis, though, are very small, increasing in the last cervical to about three inches in length. The first to the ninth dorsal, or true thoracic, ribs, those articulating with the cartilaginous sternum through the intervention of cartilaginous ribs, are of nearly equal length, about eight and one-half inches, and are moderately curved. The eleventh dorsal rib is but four inches long, and thence to the thirty-fifth or last, they decrease gradually to about two inches. The rib-bearing processes, as well as the vertebræ themselves, do not differ much throughout the series. The longest costal cartilage preserved does not measure over four inches; this will give, with the sternum and vertebræ, a total circumference of the thorax not exceeding thirty inches.

Immediately following the last costiferous vertebra, are seven vertebræ with elongate transverse processes, and without chevrons. From the position of the pelvis, it was evidently attached to the first of these vertebræ, none of which can be properly called lumbar. With the first chevron-bearing vertebra, the transverse processes begin to decrease in length, and finally disappear in the twenty-fifth or twenty-sixth.

The tail is elongate, slender, and compressed, the spines and chevrons having their greatest length only about one foot from the extremity, where the tail measures nearly six inches in height.

Of the paddles little need be said. The hind pair was decidedly smaller and less strong than the fore pair, the latter having an outstretched expanse of about thirty inches.

As a whole, this, one of the most specialized species of the most specialized genus of known extinct or recent lizards, was most marvellously serpentine and slender in its build, with an elongate, flattened, pointed head, short neck, very slender body, long, lithe, and vertically flattened tail, small but broad and strong paddle-like limbs. It is doubtful whether there was ever another vertebrated animal so admirably adapted for rapid and varied movements through the water. Though the smallest of the Mosasaurs, it was by far the most graceful in its proportions, the most delicate and exquisitely constructed in its details.

It is certain that none of the Kansas forms of this order were covered with bony scutes, as described by Marsh, the bones so described being, undoubtedly, sclerotic plates.

S. W. WILLISTON.

University of Kansas, Dec. 1.

Autumn Colorations.

IN investigating this subject the first question is, What causes the variation in coloration? This may be answered by saying that it is a natural ripening of the leaf, a change in the coloring matter of the leaf called chlorophyl. One botanist has said: "The green matter in the tissue of a leaf is composed of two colors, red and blue. When the sap ceases to flow in the fall, and the natural growth of the tree ceases, oxidation of the tissue takes place. Under certain conditions, the green of the leaf changes to red; under different conditions, it takes on a yellow or brown tint. This difference in color is due to the difference in combination of the original constituents of the green tissue, and to the varying conditions of climate, exposure, and soil. A dry, cold climate produces more brilliant foliage than one that is damp and warm."

It is said by some who have visited England that in many places the ivy, so much cherished by the English people, is being replaced by our American ivy, Ampelopsis quinquefolia, although in that climate it does not take on as beautiful tints as it does in this country, but yet is far ahead of the English ivy. Another botanist, who has visited southern Germany and Switzerland, says that our American ivy is used very extensively in that country for decorating all sorts of buildings, and that the leaves take on more beautiful tints than he ever saw in this country. This may be partially due, however, to the contrast between the vine and the almost universally white color of the buildings in those river valleys.

We may conclude, then, that climate has much, but not all, to do with the variation in coloration for different plants of the same species in the same locality; in fact, different parts of the same plant vary in coloration. Just what makes this difference is an open question. It will be noticed that in many places where one leaf overlaps another that the under leaf is variable in color and that some are variable where they have not been thus immediately overlapped. So we see that in some respects it resembles the coloring of the skin of the apple. For, if an apple naturally red at maturity, is partially covered, the covered portion remains green. So far is this true that if a paper band is put around the apple before it begins to turn the skin will not color under the band. In this way a person can put his initials or his full name upon an apple. This might also be done with the leaf, but the covered portion would not remain green, and might be of the same shades as the exposed portion. This shows that the coloring of the leaf resembles, but is not identical with, that of the apple. The same may be said with reference to the grape. It has been proven time and again that the grape colors fully as well partially or completely covered as when exposed and, too, to just the same color. This is probably due to the fact that the grape skin itself is nearly transparent and the coloring matter is in the pulp immediately next it. The coloring of the leaf resembles these sorts of coloring more than it does the coloring of flowers. For, if a rose be naturally red, it is thought, I believe, that it will be brighter red when fully exposed.

Just here we might suggest that, by propagating from individual plants that bear very bright, highly-colored leaves, in a few generations it might be possible to get a tree the leaves of which would be much brighter than the one with which we started.

The general brightness of the coloring of the leaves probably depends largely upon the weather during the time of the ripening of the leaves. This present autumn of 1891 is a poor season for bright colorations in the vicinity of Columbus, Ohio, at least. This may be partially due to the dry weather late in September and early in October.

It would require careful observation on particular plants for a number of years to prove that the weather has the greatest influence. Two plants in particular may be noticed. One is a Japanese species of Ampelopsis on the west side of a brick building. Last autumn the leaves showed great variation in color, making the vine attractive, but this autumn the leaves turn brown and dry up on the vine, and are rather unsightly. The other is a small tree, generally known as "sweet gum," or "American liquidamber" (L. styraciflua), standing in an exposed position. Last autumn the tree showed great variation in coloration, but this autumn nearly all the leaves turn a dull yellow or brown.

By referring to my diary, I find that in 1890, from Sept. 15 to Oct. 31, there are fifteen days where the weather is recorded as more or less rainy, namely, Sept. 26, 27, Oct. 4, 5, 11, 14, 15, 16, 25, 26, 28, 29, 30, 31; while for the same time in 1891 only seven days are recorded as more or less rainy, namely, Sept. 30, Oct. 4, 6, 14, 18, 19, 20. We may infer from this that wet weather makes bright colored leaves. Jack Frost probably plays his role, and the food of the plant in all probability is an agent in the matter. However, even this fall our trees and shrubs are affording us many specimens of Nature's handiwork worthy of the highest admiration. Dame Nature does not venture to denude all her trees and shrubs without making some to please the eye of man.

This leads us to the question, Is this all mere chance, or is it done for a purpose? In the case of the coloring of the fruits and flowers, it is evident that it is for the reproduction and distribution of the species. But in this case it can scarcely be for either of these purposes. If it is for the protection of birds or insects by resemblance, it serves its purpose very poorly indeed. However, let the cause be what it may, let the purpose be what it may, we always enjoy them, and thus they serve a purpose.

It is surprising how little attention our authors have given to this subject. They have found "sermons in stones and books in running brooks." Is there not enough of beauty in it to give a poet the inspiration, if that is what is wanting? One poet has said,—

"Heaped in the hollows of the grove,
The withered leaves lie dead;
They rustle to the eddying gust,
And to the rabbit's tread."

Longfellow's words are familiar to all:—

"The day is cold and dark and dreary;
It rains, and the wind is never weary.
The vine still clings to the mouldering wall,
And at every gust the dead leaves fall,
And the day is dark and dreary."

We do not find even an allusion to the beautiful coloring of the leaves no more than if they were always brown and sear.

Lastly, we might ask,—

How might not the trees have been made?
Intransplantable by shovel or spade,
Not one twig on a leafy bower,
Blooming in beauty or bearing a flower;
Not one leaf changing its hue
To blend so beautifully with heaven's own blue,
Not one form to please the eye
While towering upward toward the sky.

E. E. BOGUE.

Ohio State University, Columbus, O., Nov. 11.

Beech-Tree Struck by Lightning.

I SEND you an additional note on the beech-tree struck by lightning in July (*Science*, Aug. 11). The tree in question was one of a group of four beech trees and one ash tree, it was an old tree and only in half-leaf at the time. It has since withered almost entirely. That it really was struck there can be no doubt, as I was sitting at a window within fifty yards of it, and I knew by the sound that something had been struck, as the report was sharp and sudden, not reverberating, and was simultaneous with the flash, and, upon going out immediately afterwards, I found the upper part of the trunk and branches freshly bared and the bark strewed at the foot of the tree. T. D.

York, England.

The Crescent Moon with a Star within its Rim.

THERE is one passage in the poem of the "Ancient Mariner" which had always been a puzzle to me until a few years ago, when I observed a phenomenon which I think supplies a satisfactory explanation of the meaning of the author. The lines referred to are those in which the crescent moon is described as having a star within its rim. I was in the south of England at the time, and the phenomenon which I saw was as follows: One clear evening, when the moon was in the first quarter, I observed a bright spot resembling a small star or planet upon the shaded surface of the moon at a considerable distance from the illuminated portion of the satellite. This I have no doubt was due to the beams of the sun being reflected from the summit of one of the higher peaks before they had illuminated the surrounding country. I have no doubt the passage in question was suggested to the mind of the author by his having been witness of some similar phenomenon, although I have never heard of it being visible to the unaided eye. T. D.

York, England.

BOOK-REVIEWS.

Masterpieces of American Literature, with Biographical Sketches. Boston, Houghton, Mifflin, & Co. 12°.

THIS book was prepared at the suggestion of the Boston school authorities, and is designed both as a reading book and as an introduction to American literature. The authors represented are thirteen in number, including Franklin, Irving, Whittier, Lowell, and others, and the selections embrace a variety of articles in many departments of literature, both in prose and in verse. The selections are longer than those in ordinary reading books, the whole of Whittier's "Snowbound," for instance, being given, while other authors are represented either by entire works or by long extracts. It is stated in the preface that the Boston school authorities "planned the book and approved every selection;" but, if they did, we cannot think they are to be wholly commended as judges of literature. The book contains too many doggerel verses, while, on the other hand, it presents some striking deficiencies. For instance, there is not in the whole book a single extract from our historians, although it is well known that we have better works to show in history than in any other department of literature. Moreover, there is not a religious article in the book, and very few that are even ethical; so that the collection cannot be regarded as a satisfactory epitome of the best American literature. The omissions are the more to be regretted because ethical and historical works are especially adapted for the instruction of the young. American literature is but a narrow field at best, and gleaners in it cannot afford to neglect any portion of it, least of all that portion from which the most useful moral lessons may be learned. We hope, therefore, that, if ever the book reaches a second edition, some changes will be made in its contents.

AMONG THE PUBLISHERS.

— The third edition of "Electricity, treated Experimentally for the Use of Schools and Students," by Linnæus Cumming, has been published by Messrs. Longmans, Green, & Co. The author has made such additions and alterations as seemed necessary to bring the book up to date.

— John Wiley & Sons have in preparation a "Manual of Experimental Engineering," by Professor R. C. Carpenter of Sibley College.

— Moses King of Boston, the maker of hand-books on various cities, now announces a new work, to be called "King's Handbook of New York City."

— Messrs. Whittaker & Co. have in the press a second edition of Dr. A. B. Griffith's "Treatise on Manures." It is a little more than two years since the work appeared. Fifty pages of new matter have been added.

— The January number of *Scribner's Magazine* marks the beginning of the sixth year and eleventh volume of a periodical which has already attained a circulation of more than 140,000 copies monthly.

— D. Appleton & Co. have under way a subscription-book of considerable importance, edited by Professor Shaler of Harvard. It is to be a general review of the America of to-day based upon the reports of the last census. The contributions to this volume will be by experts and men of high standing in the profession for which they speak.

— The next volumes of Swan, Sonnenschein, & Co's Social Science Series will be "Poverty, Its Genesis and Exodus," by J. G. Godard, and "The Trade Policy of Imperial Federation," by Maurice H. Harvey, who lately wrote an article on the subject in the *Asiatic Quarterly Review.* A translation of the new book of M. Ostrogovski, "La Femme au Point de Vue du Droit Publique," is to appear in the same series at an early date.

— D. C. Heath & Co., Boston, will soon issue the first four books of "Dichtung und Wahrheit," edited for them, with introduction and notes, by Professor C. A. Buchheim, editor of the Clarendon Press Series of German Classics. The edition will be especially adapted for pupils preparing for entrance to college, offering an advanced requirement in German, but will also have in view the numerous colleges that devote a portion of their time to the reading of Goethe's prose.

— The frequent reports that Russia is about to seize Bokhara will lend interest to the article by the Rev. Henry Lansdell, D.D., in the January *Scribner*, entitled "Bokhara Revisited." In this article he says: "It was not the policy of the Resident to interfere more than is necessary in the domestic affairs of the Khanate, except when they related to Russian subjects; and as for annexing the Khanate, 'why,' as one asked of me, 'should they do that?' To administer the country in Muscovite fashion would cost a great deal more than the taxes would pay for, and if the Russians want anything done, they have simply to nod to the Emir and he does it. They are much too wise, therefore, to annex Bokhara, but if need arises it can of course be done at any moment."

— *The Chautauquan* for January presents the following among other articles in its table of contents: Domestic and Social Life of the Colonists, IV., by Edward Everett Hale; Trading Companies, by John H. Finley; Physical Life, IV., by Milton J. Greenman; National Agencies for Scientific Research, IV., by Major J. W. Powell; Science and the Feeding of Animals, by V. Hallenbeck; Progress in the Nineteenth Century, by Edward A. Freeman; Some Propositions of Nationalism, by Edward Arden; Niagara the Motor for the World's Fair, by Professor John Trowbridge; The Kindergarten Movement in Chicago, by Antoinette Van Hoesen Wakeman; How Women Figure in the Eleventh Census, by Margaret N. Wishard; Women's Robes in the Orient, by Countess Annie de Montaigu.

— The American Academy of Political and Social Science has just published an essay on "Some Neglected Points in the Theory of Socialism." The author is T. B. Veblen of Ithaca. The monograph was written with the purpose of finding an economic ground for the existing unrest that finds expression in the demands of Socialists. The work is a criticism of Mr. Spencer's essay, "From Freedom to Bondage," and though Mr. Veblen claims to be rather a disciple than a critic of Mr. Spencer, he hardly proves himself such. The author shows very clearly how, under our present system, there is a constant effort even at the expense of real physical comforts and even necessities to make a greater display of one's ability to pay than one's neighbors. This "Economic Emulation" he regards as the chief underlying cause of the present socialistic agitation.

— The success of *The Atlantic Monthly* in certain departments during the last year or two will be continued during the year 1892, as shown by the following announcements. All the attractions which it will contain cannot, however, be mentioned here. The papers on marked men will include articles on George Bancroft, by W. M. Sloane; Orestes A. Brownson, by George Parsons Lathrop; John Esten Cooke, and Philip Pendleton Cooke, by Thomas Nelson Page; and James B. Eads, and others, will be continued. "An American at Home in Europe" is a series of papers by William Henry Bishop, the novelist, giving the experience of an American family which established itself abroad. Mr. Bishop tells about his experiences in daily living in Paris, Versailles, St.

Germain; the country and seacoast of France,— Dinan, Cherbourg, St. Malo, Pau; in Spain; in England,— Oxford, Windsor, Canterbury; in Italy,— Rome, Venice, Lucca, and Verona. Besides contributing fiction to the magazine, Mr. Henry James will furnish a paper of reminiscences of James Russell Lowell's London life. The "Studies of American Cities" are not mere descriptions, but criticisms, with a view to understanding the character of the cities which have the greatest influence on American life. The first of these will be a paper on Boston, by Ralph Waldo Emerson, now first published. "Private Life among the Romans" will be described in a paper by Miss Harriet Waters Preston and Miss Louise Dodge, whose joint studies of episodes of ancient history have won such high praise. Lafcadio Hearn will contribute some delightfully picturesque and graceful papers on Japanese life, as seen by a resident in Japan; and Mr. E. F. Fenollosa will discuss the influence of Japanese art on the art of Europe and America, in an early number. The best interests of the higher life of towns and cities will be considered in a series of papers on "Parks for Small Towns," "Local Museums of Art," "Free Libraries," etc. Papers on the Civil History of Our Country in War Time will be a feature of *The Atlantic* for 1892, and will be begun by an article by an eminent Southern scholar, giving the grounds for his unquestioning adherence to the Southern cause; and one by a distinguished man of science from a Border State, accounting for his own decision in the same emergency. Attention will be given this year to education generally, and especially to the education of girls and women. These papers — from the most eminent authorities — will follow in the same line as those by President Gilman, Professor Shaler, Dr. Cleveland Abbe, and others, which have appeared during the past year. The critical reviews of new books that are talked about will be continued.

— The December number of *The Engineering Magazine* contains a paper on "Landscape Beauty at Newport," by John De Wolf, which treats the subject from the standpoint of giving definite and practical ideas. In the same number is the first of Professor Coleman Seller's series, entitled "American Supremacy in Applied Mechanics," which should be read by every one who desires some knowledge of the men and the forces which have wrought such astonishing changes in this age of engineering and mechanical progress. Other papers in the same number are "A Permanent Census Bureau," by Edward Atkinson; "Geology from a Business Point of View," "Picturesque Suburban Railroad Stations," "Impure Water and Public Health," "Fulton Night with Mechanical Engineers," "Conditions Causing a Cold Wave," "The Canadian Pacific Railroad."

— A new edition of "A Girl in the Karpathians" is announced by the Cassell Publishing Company. It will contain a new portrait of the author, Miss Menie Muriel Dowie (now Mrs. Henry Norman), and a preface and introduction written by her especially

Publications received at Editor's Office, Nov. 18–Dec. 15.

CARPENTER, WILLIAM B. The Microscope and its Revelations. Seventh Edit. revised by W. H. Dallinger. Philadelphia, Blakiston. 1,099 p. 8°.
DRUGGISTS' Reference Book, 1892. Philadelphia, Blakiston. 24°.
FINDLAY, GEORGE. The Working and Management of an English Railway. New York, Macmillan. 351 p. 12°. $1.50.
HARPER, WILLIAM R., and BURGESS, ISAAC B. An Inductive Latin Primer. New York, Amer. Book Co. 424 p. 12°.
HOUGH, ROMEYN B. American Woods. Part I.: Wood Specimens in book-form, showing tranverse, radial and tangential sections. Lowville, N. Y., R. B. Hough. $5.00.
LOEWY, BENJAMIN. A Graduated Course of Natural Science Experimental and Theoretical for Schools and Colleges. Part II. New York, Macmillan. 257 p. 12°. 60 cents.
LOMBROSO, CESARE. The Man of Genius. New York, Scribner. 370 p. 12°. $1.25.
MASSEE, GEORGE. The Plant World. New York, Macmillan. 212 p. 12°. $1.
OCHOROWITZ, J. Mental Suggestion. Parts I.–IV. New York, Humboldt Publishing Co. 369 p. 8°. $1.20.
PETERS, EDWARD DYER. Modern American Methods of Copper Smelting. New York, Scientific Publishing Co. 398 p. 8°. $4.
PHYSICIAN'S Visiting List for 1892. Philadelphia, Blakiston. 24°.
SHALER, N. S. The Story of Our Continent. Boston, Ginn. 290 p. 12°.
SLOANE, T. O'CONOR. Electricity Simplified. New York, Henley. 154 p. 12°. $1.
TRIMBLE, HENRY. The Tannins. Vol. I. Philadelphia, Lippincott. 168 p. 12°. $2.
WAHNSCHAFFE, FELIX. A Guide to the Scientific Examination of Soils. Tr. by William T. Brant. Philadelphia, Baird. 177 p. 12°. $1.50.
WYATT, FRANCIS. The Phosphates of America. New York, Scientific Publishing Co. 187 p. 8°.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—*Science*, No. 178, July 2, 1886, also Index and Title-page to Vol. VII. Address N. D. C. Hodges, 874 Broadway, New York.

A YOUNG MAN (31) would like a position in a college, laboratory, or observatory, is also willing to assist at a steam engine, etc. Address J. W., care of *Science*, 874 Broadway, New York.

WANTED.—A position in the philosophical or pedagogical department of a college or university by a young man (30) who has had five years' practical experience in teaching, and who has done four years' post-graduate work in philosophy, devoting his attention during the last two years especially to study and original investigation in scientific psychology and its applications in education. Address E. A., care *Science*, 874 Broadway, N. Y. City.

WANTED.—A suitable position in Washington, D. C., not connected with the Government, and with a salary not to exceed $650 a year, by an experienced biologist with six years' university training. Applicant has been a skilful surgeon for fourteen years; is a practical photographer, cartographer, and accustomed to the use of the typewriter. He is also capable of making the most finished drawings, of any description, for all manner of illustrative purposes in science; trained in museum methods and work; also field operations and taxidermy in its various departments, and modeling, production of casts, restorations of paleontological specimens and similar employments. Address U. S. R., care *Science*, 47 Lafayette Place, N. Y.

WANTED.—By a young man (27), B.A. and Ph.D., with three years' experience as assistant in chemistry, position as instructor in chemistry or in natural sciences in college or academy, or other advantageous position as chemist. Give particulars as to work, salary, etc. F. W. MAR, L. Box 23, West Haven, Conn.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

Wanted to buy or exchange a copy of Holbrook's North American Herpetology, by John Edwards. 5 vols. Philadelphia, 1842. G. BAUR, Clark University, Worcester, Mass.

For sale or exchange, LeConte, "Geology;" Quain, "Anatomy," 2 vols.; Foster, "Physiology," Eng. edition; Shepard, Appleton, Elliott, and Stern, "Chemistry;" Jordan, "Manual of Vertebrates;" "International Scientists' Directory;" Vol. I. *Journal of Morphology;* Balfour, "Embryology," 2 vols.; Leidy, "Rhizopods;" *Science*, 18 vols., unbound. C. T. McCLINTOCK, Lexington, Ky.

For sale.—A 6½ x 8½ Camera; a very fine instrument, with lens, holders and tripod, all new; it cost over $40; price, $25. Edw. L. Hayes, 6 Athens street, Cambridge, Mass.

To exchange Wright's "Ice Age in North America" and Le Conte's "Elements of Geology" (Copyright 1882) for "Darwinism," by A. R. Wallace, "Origin of Species," by Darwin, "Descent of Man," by Darwin, "Man's Place in Nature," Huxley, "Mental Evolution in Animals," by Romanes, "Pre-Adamites," by Winchell. No books wanted except latest editions, and books in good condition. C. S. Brown, Jr., Vanderbilt University, Nashville, Tenn.

For Sale or Exchange for books a complete private chemical laboratory outfit. Includes large Becker balance (200g to 1-10mg.), platinum dishes and crucibles, agate motors, glass-blowing apparatus, etc. For sale in part or whole. Also complete file of *Silliman's Journal*, 1862–1885 (62–71 bound); Smithsonian Reports, 1854–1883; U. S. Coast Survey, 1854–1869. Full particulars to enquirers. F. GARDINER, JR., Pomfret, Conn.

For exchange or sale at a sacrifice, an elaborate microscope outfit. Bullock stand; monocular objectives, one-sixth homogeneous immersion, four-tenths, and three inch, Bausch & Lomb, also one-fourth and one inch Spencer. Four eye-pieces. Objectives are the best made. Address Mrs. Marion Smith, 41 Branch Street, Lowell, Mass.

for this edition. The new portrait shows us a pretty woman, without the slightest suggestion of anything masculine about her. The same firm announces a new edition of the Hon. Chauncey M. Depew's "Orations and After-Dinner Speeches;" also a life of "Henriette Ronner, the Painter of Cat Life and Cat Characters," by M. H. Spielmann, editor of the *Magazine of Art*. It is for her pictures of cat life and cat character that Mme. Ronner has gained her reputation. A book that is bound to attract attention is "Shall Girls Propose?" which the Cassell Publishing Company issue. It is written by a "Speculative Bachelor," and comes just in time for the new year, which is leap year.

— The forthcoming January number of *The Alienist and Neurologist* will contain: "Neurasthenic Rudimental Impulsive Paranoia," by Professor Enrico Morselli, Italy; "The Work of Medicine for the Weal of the World," by C. H. Hughes, M.D., St. Louis; "Some Cases of Hemiplegia," by John Ferguson, M.D., Toronto, Canada; "Relations of Chorea and Epilepsy," by G. R. Trowbridge, M.D., Danville, Penn.; "The Virile and Other Reflexes," by C. H. Hughes, M.D., St. Louis; "Diagnosis and Nature of Certain Functional and Organic Nervous Diseases," by J. T Eskridge, M.D., Denver; "Traumatic Neurosis in Damage Suits," by H. T. Pershing, M.D., Denver; "Present Aspect of Cerebral Surgery," by L. C. Gray, M.D., New York City; "Visual Imagery of Alcoholic Delirium," by C. G. Chaddock, M.D., Traverse City, Mich.; "Insanity and Genius," by James G. Kiernan, M.D., Chicago; besides the usual selections, editorials, hospital notes, reviews, etc.

— Ginn & Co. announce *The Philosophical Review*, Vol. I., No. 1, to appear January, 1892, and to be edited by J. G. Schurman. The contents are: "Prefatory Note," "The Critical Philosophy and Idealism," by Professor John Watson; "Psychology as So-called 'Natural Science,'" by Professor George T. Ladd; "On Some Psychological Aspects of the Chinese Musical System," by Benjamin Ives Gilman; Reviews of Books; Summaries of Articles.

SCIENCE

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SCIENCE

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THE RELATIONS OF GEOLOGICAL SURVEYS TO SUCCESSFUL MINING.[1]

THE subject assigned to me for presentation to-night is, The Relations of Geological Surveys to Successful Mining. Other papers have been read to you and addresses have been made descriptive and eulogistic of the mineral resources of Missouri. It remains for me to present to you how such an organization as I have the honor to direct aids in their development. It gives me pleasure, gentlemen, to appear before you to discuss so fertile a theme as this. I would that I had time to attempt to do it full justice. I feel also gratified in being asked to do so before such a body of mining and business men, because we geologists are often led to believe that, among you busy men of affairs, there is sometimes a feeling that a scientist is a poor sort of creature anyhow, who spends his time hunting fossils or learnedly ventilating elaborate theories which nobody knows how to make use of. This we feel, of couree, is all wrong, and especially that you are all wrong, and hence such opportunities as this, where we can stand up and make it quite clear to you how you are all wrong, without your having a chance to reply, are always to be coveted.

But before we can proceed to do this let us understand what we are going to talk about. First, then, what is meant by the term "mining" in this connection? Mining, strictly speaking, is a process of excavating certain materials from the ground. With such actual mining of ore I must confess that our work has only indirect connection. This must be left to the judgment, energy, and perseverance of the miner, and the success of any mining venture is always largely dependent upon his genius in overcoming the difficulties encountered. But over and above this, the magnitude and importance of a mining industry is dependent first upon the nature of the materials mined, and second upon the extent to which these materials are used. I take it, therefore, that the sense in which it is meant that mining shall be considered upon this occasion is the broad one embracing all that is concerned, not only with the production of minerals, but also with their complete utilization; or, briefly, I will define it as the exploitation and the utilization of the mineral possessions of an area. The question now stands, therefore, what are the relations of a geological survey to these ends? To properly answer this it first becomes necessary to consider what are the fundamental requirements for the successful exploitation and utilization of the materials considered.

Manifestly the first thing necessary for the inception of mining is the discovery of the existence of the materials worthy of mining. It seems so perfectly clear that there can be no mining of a material without the presence of that material, that I would not say even these few words on so self-evident a statement, did not such facts as Missouri's tin mines and Arkansas's gold mines seem to stare me in the face in refutation of my proposition. Still, I will not yield my point, but merely elucidate it by adding that attempts at mining can always be made, as many of you doubtless know to your sorrow, without any foundation whatsoever.

Second, and next in importance to the discovery of existence for the development and sustenance of a mining industry, is the determination of the quantity and distribution of the material to be mined. A substance may exist, but it may be in such a small quantity as to be unworthy of consideration, as are, I fear, the tin ores of the United States. Or it may exist in large quantity, but be so disseminated or diffused as to be unattainable with profit, as is the gold which occurs in places, in the sands of northern Missouri. Finally, it may be both in large quantity and concentrated, but inaccessible, either by reason of its existence at excessive depths, as are some coal beds, or by reason of topographic isolation or geographic remoteness with absence of means of transportation, as are some of the iron and other ores of this State.

Third, in addition to the facts of existence and distribution, that mining may attain its fullest vigor and soundest prosperity it is necessary that the qualities and capabilities of the materials be exhaustively determined. This is important in both a negative and a positive way, according to whether the results prevent useless undertakings or direct enterprise in the right direction. An ore may be abundant and its distribution well known, yet it may be so lean, or so injured by impurities, as to be of low value, or even entirely worthless. A building-stone may be of handsome appearance and may be obtainable from the quarry in large blocks, yet when exposed to the condition of atmosphere and temperature of a large city, it may deteriorate rapidly. A superior clay may be used for ordinary purposes for which an inferior product would answer just as well, and a determination of its qualities may lead to its increased use for many other purposes, with enhanced value.

Different coals are put to different special uses. The determination of the essential properties of any one coal will lead to its ultimate use for all the purposes it is best adapted to. An uncommon but valuable material may lie neglected in great quantities, simply because its capabilities are not appreciated. This was the case for many years with the anthracite coal of Pennsylvania, which was practically ignored simply because people did not know how to burn it; a material which is now mined at a rate of nearly fifty million tons per year.

Fourth, and finally, as a necessary supplement to the dertermination of the existence, distribution, and properties of materials, is the dissemination of the knowledge in a way which will reach those who should know, and in a manner which will command their attention. If the knowledge of the existence of useful materials is confined to an individual or to a small circle, their development will be slow. The information must reach the right ears for the full effect to obtain; and not only that, it must reach those ears in the right way or it is not credibly received. The world is too full of vague rumors, of bubbles and booms, for startling or even all rational seeming statements to gain ready credence. People are more inclined to be incredulous of such good news than credulous, unless it is backed by well-known authority.

Thus reviewing what I have said so far, four fundamental requirements for the development and sustenance of a substantial mining industry are:

1. The discovery of the existence of the materials.

2. The discovery or determination of their quantities and distributions.

3. The discovery or determination of their qualities and capabilities.

4. The proper dissemination of the knowledge of these facts.

These being granted as fundamentally necessary for the development of mining, it follows that any work having for its object the accomplishment of these ends is, in intention at least, a contributor to the success of such industry. That conclusion follows logically and is necessary; the degree to which it is a contributor depends upon the extent to which it attains its objects. The relations of a geological survey to successful mining will hence be well displayed by a consideration of the manner in which it contributes to the four ends specified.

First, then, with relation to the discovery of the existence of

[1] An address delivered by Arthur Winslow, State Geologist of Missouri, before the Inter-State Mining Convention, held in Springfield, Mo., Dec. 15-17, 1891.

materials, how and to what extent does a geological survey accomplish this? Well, to answer this question satisfactorily we must first determine what is meant by the term "discovery." The date when the existence of any one material first became a fact in the consciousness of man can never be stated. It is probable that the gold in California was known to exist by the aborigines, merely as glittering particles or nuggets of undetermined properties, long before the "white man" made the fact of its existence known, or, as we say, discovered it. It is probable that many a block of silver ore was seen and handled unrecognized by the pioneer long before mining first began. Again, it is probable that the primeval savage of California both knew of the existence of the gold and was familiar with its general properties and value, yet from the isolation and barbarism of his surroundings the fact of existence was never made through him the property of the civilized world. Hence, so far as its effect on civilization is concerned, we must define discovery of existence as that event whereby a material is brought to the knowledge of an individual who recognizes it and who has a conception of its value, and who transmits the fact of existence to the world. Such a work of discovery constituted a large part of the functions of the early explorations throughout the country of the earlier geological surveys. The more general facts of existence were then sought after, knowledge was so imperfect. This was the necessary foundation for further investigation for future development. Nowadays the work of geological surveys is tending more to the solution of other questions.

With reference to Missouri as a whole, it may safely be said that we do not look for the discovery in the future of the existence in considerable quantity of a single mineral substance of great economic value, the existence of which is not already known. But though, in this large sense, such is, strictly speaking, true, in a narrower sense, and in the sense that the existence of materials in special localities is being brought to the knowledge of men who will recognize them and make the facts known to the world, discovery is still in progress in the State and constitutes an important part of the work of the geological survey. Discoveries of this kind of iron-ores, zinc and lead-ores, clays and coals, and other materials have been made throughout the State during the past year, and the results will be published in the forthcoming reports. Such discoveries are made by all well-conducted geological surveys, and they are thus extensive contributors to the first requirement for the development of a mining industry.

The discovery or determination of the quantities and distribution of materials is, however, nowadays recognized as one of the principal directly economic functions of a geological survey, and it is the work requiring the highest attainments and the most studious and exhaustive investigation. The science of geology is here called into play, and the knowledge accumulated during many years by multitudes of observers is applied for the solution of the problems. The mere existence of a material may be determined by any one with a small stock of knowledge and a rambling search. The quantity and distribution can generally be deduced only from a host of facts gathered with close and patient observation, and then studiously and logically handled. It is first an inductive and then a deductive process. The general laws and facts of geology have to be known before a correct diagnosis can be made. Therefore, just as a physician can best treat a patient if he knows his structure, constitution, and habits well, so a geologist can best accomplish his results if he knows thoroughly the geological structure of the area he is examining, and the laws governing its phenomena. Hence it has come to be recognized in theory, and is accepted in the best practice, that the most valuable and far-reaching results are attained when the fundamental facts of the geology of an area are mastered. A due regard for logic demands that the general principles shall be established before we attempt the solution of particular cases. To illustrate, most of the rocks exposed in Missouri and adjacent States are what are called clastic or sedimentary rocks, and occur in strata, or layers, piled upon each other like the leaves of a book. Each layer is, however, not co-extensive with the area of the State, but generally the uppermost occupies the smallest area, and those underlying it protrude beyond it successively in constantly expanding zones, so that their limits are defined on the map by a series of roughly concentric lines, or, as has been said by Lesley, like the grain lines of a polished piece of wood, planed at a low angle across the grain.

Some minerals of value frequently characterize certain strata or formations; this is especially the case with coal, iron, and clays, and sometimes with lead and other ores. Hence, if the distribution of these strata is once defined, through the study of the geology, the value of the knowledge as a guide to prospecting for all future will be readily appreciated. This definition of the areas of the strata or geological formations is hence recognized as an important duty of a geological survey. Here it is that fossils are of use. Some fossils are restricted to certain strata, or, more exactly speaking, different strata have different faunal characteristics; hence, fossils become ear marks which help us to recognize outcrops as belonging to certain formations and lead us to a correct classification of the scattered occurrences. For example, suppose that over a coal bed worked at a point, A, is a bed of limestone characterized by certain fossils At a point, B, is another coal mine, and the question arises as to whether the bed at B is the same as that at A. Or, in other words, have we at B one or two coal beds, a question of much economic importance. A close examination in the creek bed below the outcrop of coal at B reveals the existence of a limestone bed with the same fossils as those found over the coal bed at A. Hence, the inference is direct that that the coal of A underlies the coal of B, and will be found on investigation.

In working out the distribution of the geological formations on the ground this end is the immediate and controlling one to the field geologist, and its economic value is not always in his mind; and to a still smaller degree is the fact ordinarily appreciated by the layman; hence the former's operations are frequently regarded, by those of ultra utilitarian minds, as mildly idiotic. In illustration, an assistant of mine on the Arkansas survey, a capable and well-trained man, was at one time engaged in tracing the outcrops or limits of a certain stratum of sandstone in the coal measures of that State. He stopped one night at a farmer's house for lodging. After the evening meal, the host and his guest having settled themselves in front of the blazing log heap of a fire, which all Arkansas travellers enjoy, the farmer, learning the vocation of his guest, thought he would seize the opportunity to obtain some useful information. "Well, my friend," he began, "have you discovered any mineral about here?" "No," answered the young man, who was somewhat shy and non-communicative. "Not found any!" echoed the farmer; "well, now, that's too bad. Don't you think you will find some soon?" he questioned. "No," again answered the young man, who was strong in monosyllables. "Haven't found any and don't expect to find any, !" ejaculated the somewhat astonished questioner; "well, what do you stay here for, then?" "I am not looking for mineral," was the young man's brief reply. "Not looking for mineral!" exclaimed the dumbfounded and now somewhat irate farmer; "then what in the name of creation is your work good for?" Here, then, were two men at loggerheads simply for lack of a little explanation. The young man was tracing a stratum, which, when transferred to the map, would define the area of an important coal bed. Absorbed in the immediate object of his work, he lost sight of a part of its outcome; he was in one sense engaged in the actual "discovery of mineral" without being entirely conscious of it. A few words of explanation might have made all clear.

These illustrations will suffice to explain how the determination of the general facts of stratigraphic structure are of broad economic value. The definitions of the members of the oil-sand group, in Pennsylvania, of the Trenton limestone in Ohio, permitted the intelligent and rapid development of the oil industry.

Similarly the determination of the sources of our ore bodies, of their modes of formation is of fundamental importance, is indispensable for the construction of the correct theory of their distribution, which alone will lead to their full development, and which will prevent waste through expenditure in the wrong direction. I could illustrate this in detail, but time will not permit, and I think the principle is already made clear. Such are some of the discoveries of geologic science; these are the results which we strive to express in our maps and reports, over and above the details of occurrence. The latter serve as a means for attaining the former and are necessary for that purpose. They are gathered sedulously in the field and are studied in the office. Thus, in the office, are most of the discoveries of modern science made. The facts of observation are our mediums, the laws of reasoning are our divining rods and witch-hazels. The determination of the qualities and capabilities of materials we have recognized as an important pre-requisite to the full development of a mining industry. Such work is also properly made the function of a geological survey. Some materials show on their faces, from mere inspection, what their value is; such being the case with most of the zinc and lead ores of this region. Others need more or less elaborate tests for the fact to be determined. Iron-ores may appear and be rich in iron contents, yet they need to be analyzed to determine the amounts of sulphur, phosphorus and silica, which they contain before their capabilities can be predicted. Mineral waters need similarly to be analyzed before their beneficial qualities can be known. Coals and clays need similar treatment, and in addition they should be subjected to exhaustive tests, on a working scale. An analysis of a building stone yields little knowledge as to its capabilities, and here the thorough experimental test is alone capable of demonstrating just what the value of the stone is. The analysis and tests above enumerated are either actually or prospectively part of the work of the Geological Survey, and most valuable results have been reached, especially with the clays of the State, which will be incorporated in future publications. That the additional information thus acquired concerning the mineral deposits of the State will contribute to their further development seems indisputable.

Finally, in what way does a geological survey disseminate knowledge concerning these materials and is this way an effective one? A geological survey, if properly organized, is composed of professional men of scientific attainments and of undoubted integrity; it is an official organization, and its examinations are made disinterestedly, and on the truthfulness of its results depends the reputation of its members. Its publications are widely circulated; they are designed to be used by the professional man and also by the layman; being official, and coming from such a disinterested and qualified source, the results are accepted generally without hesitation by the capitalists or manufacturers. Such influence and acceptance could never be reached by reports emanating from owners of property or other interested parties, nor would the judgment of such concerning theories of distribution or quality command respect, unless emanating from well known expert sources; thus the capital and enterprise necessary for the inception of such undertakings would be slow to follow such guidance. Hence, a good geological survey constitutes the best of advertising mediums, if you choose to call it such; advertising what is genuine and good, but never stooping to indiscriminate booming.

But another means of disseminating information exists, over and above that of publications. Some people are not reached by reports, either because they are not given much to reading, or for lack of access to the publications. They may come to the State, or even be in the State, knowing little or nothing of its natural features and products. In such cases, a State museum is the most effective means of conveying information; a museum which shall contain not only specimens of materials, but maps, models, views, diagrams, and reports concerning all that is of interest in this connection; the materials in which shall be so arranged as to convey clear ideas, not only of what is in the State, but where it is, how it occurs, and how much there is of it; which shall be supplemented by the presence of trained men, familiar with the State, who can guide the stranger in the right direction.

In conclusion, I would say a few words concerning the educating influences of a geological survey among the citizens of the area in which it operates. Through its publications, through the intercourse with its members, and in other ways, a vast amount of information is absorbed by the people concerning the land they live in and its products. This information they apply unconsciously in their various operations. It prevents them from being led into hopeless enterprises, it leads them to discountenance extravagant expectations and to recognize charlatantry, it brings them to appreciate the truly useful and valuable, and it supplies them with a source of advice which many are otherwise destitute of.

Finally, if their serious attention is aroused, they are soon brought to see in all nature that surrounds them, a wonderful relationship of parts, to read the history of a wonderful succession of events; they begin to hear the "sermons of the stones," which ever after become replete with interest and significance, exercising refining influences and acting as healthy stimulants to intellectual effort.

NOTES AND NEWS.

THE Geological Society of America will hold its winter meeting in Columbus, Dec. 29–31.

— From a report on mine ropes to the French Government, it appears that hemp or aloes ropes are almost exclusively used for all depths of shaft in Belgium. The makers guarantee the ropes to last one and a half to two and a half years, and should they fail earlier, a twelfth to a twenty-fourth of their cost is deducted for every month short of their stipulated duration. Steel-wire ropes, according to *Invention*, should be of crucible steel having a breaking strength of 70 to 76 tons per square inch. Large pulleys are more necessary for wire than for hemp ropes, the smallest diameter permissible being 1,300 to 1,400 times the diameter of the wire in the rope, if of iron, and 2,000 times if of steel. For mining purposes wire ropes are best made with a hemp core being more flexible.

— Poisoning by mussels is a well-known fact. Such poisoning appears in chronic form in Tierra del Fuego, mussels being abundant on the shores, and other kinds of food rare, so that the natives eat large quantities of the former daily, both of bad and of good quality. According to a doctor of the Argentine fleet, M. Segers, as *Nature* reports, the mussels are rarely injurious at their maximum time of growth, which corresponds with full moon, but when the moon wanes, they become poor and often poisonous. The poisonous quality apparently results from the death of a large number at this time, and the putrefaction of their bodies yielding ptomaïnes which are absorbed by the surviving mollusks. In any case, the Fuegians are often attacked by a liver complaint, consisting in atrophy of the organ, with jaundiced color of the skin and tendency to hæmorrhage; and M. Segers believes this is due to mussel poisoning. He finds sulphate of atropine an efficacious antidote.

— According to the *Lancet* a noteworthy difference between the present outbreak of influenza and those experienced last spring and the original epidemic of the winter of 1889–90 is the comparative slowness of its diffusion over the country. It was, in November, mainly confined to two widely separated parts of the kingdom, Cornwall and the eastern counties of Scotland. It is remarkable that children are attacked almost as much at adults. It is reported to be very prevalent in St. Petersburg and Berlin, while at Hamburg it reached "alarming proportions," and the weekly mortality of the city and its suburbs exceeded the average by 280. In France it is especially prevalent at Bordeaux, where many deaths among the aged have occurred. It has also appeared in Paris. In showing some patients to his students a few weeks ago, Professor Gerhardt of Berlin said, "The morbid symptoms which we comprehend under the collective name of influenza have repeatedly been observed before, and several epidemics of the so-called 'grippe' (those of 1847 and 1876, for instance) are on record. Such a pandemic, however, as prevailed two years ago had not occurred for a generation, and we had to deal with something quite new and unknown. It came to us from the East. In May, 1889, it broke out in Bokhara, rapidly overran Russia in Asia, and came to St. Petersburg in September. The disease spread rapidly all over Europe, radiating over the provinces from Berlin, Vienna, Paris, and London, and remaining mostly three or four weeks, never more than two or three months, in one place. Its course ran unmistakably from east to west; from us it went to America and then on to Eastern Asia. Now it seems to have arrived among us again after its journey round the world. The symptoms are remarkably various. The malady often takes an easy course, and is in general not very dangerous to robust people. It begins in most cases with high fever, which rapidly abates. In the graphic representation of the progress of the fever the steep and narrow one-day's curve seems to be characteristic. A vast number of sequelæ have been observed. Already existing diseases, such as pulmonary tuberculosis and diseases of the heart, often take an unusually rapid and fatal course under the influence of influenza. Influenza must be reckoned among the acute infectious diseases, and its contagious character may be regarded as proved. The spread of the disease is uncommonly rapid, and the time of incubation is often less than twenty-four hours, never more than two or three days. The question whether one attack protects the patient against future ones cannot be definitely answered; some immunity there must be, for the epidemic never lasts very long. Children are seldom attacked, sucklings never. Some people are temporarily insusceptible. Doctors, for instance, have often fallen ill at the end of the epidemic. The age from fifteen to twenty-five seems to be the most susceptible. No specific against the disease is known; the doctor must therefore confine himself to symptomatic treatment."

— Principal J. L. Thompson, of the Hawkesbury Agricultural College, New South Wales, has no doubt, according to *Nature*, that the climate and much of the soil of Australia are well suited for the culture of the olive. All that is needed, he thinks, is an adequate supply of labor. He himself has been very successful in preserving green olives; and in a paper on the subject in the August number of the *Agricultural Gazette* of New South Wales he gives the following account of the system adopted: The olives are very carefully picked from the trees when about full-grown, but perfectly green. They should be handled like eggs. If they are bruised in any way, they will become black and decompose. In the green state, olives contain gallic acid, which gives them an acrid taste. To remove this they are, first of all, steeped in alkaline water, made either of wood ashes, lime water, or washing soda; of the latter, about three or four ounces to the gallon of water. As soon as the lye has penetrated through the pulp, which is usually in from eight to ten hours, they are put into clean water, and steeped until all acrid and alkaline taste has been removed. During that time the water is changed every day. They are then put into brine, composed of one pound of salt to each gallon of water, and kept carefully covered with a thick linen cloth, for if exposed to the air they will turn black. They are finally put up in air-tight jars.

— Lépine and Barral (*Comptes Rendus*, cxii., Nos. 5 and 8) collected some arterial blood from a dog in a vessel cooled to 0° C., then defibrinated it, and at once estimated the amount of sugar it contained. Other samples of the same blood were kept at different temperatures; b at 39°, c at 49°, d at 52°, and e at 55° C., and left for one hour. After this time the amount of sugar in b was found to be $\frac{1}{4}$, in c and d $\frac{3}{10}$ to $\frac{2}{5}$ less than in a, while in e it was the same as in a. This shows that the "sugar-destroying ferment" acts better the higher the temperature, until at about 54° C. its activity is destroyed. If blood withdrawn from an artery be centrifugalized, one obtains a serum which of course contains more sugar than the original blood, because the corpuscles contain scarcely any sugar. If such serum be kept at 39° C. for some time — for example, one hour — there is no diminution in the amount of the sugar, while blood similarly treated loses one-quarter of its sugar. If the corpuscles which are separated by the centrifugalizing process be washed with saline solution, a filtrate is obtained which, if mixed with grape sugar, causes a part of the latter to disappear when the mixture is kept at 39° C. It would seem, therefore, that the "sugar destroying ferment" is present in the blood corpuscles.

— The old tower in Saragossa is doomed. It was erected four centuries ago, but it is still, as on its first day, the Torre Nueva. As an example of Spanish brickwork the tower is interesting enough, but to its inhabitants its importance consists in its rivalry to the Pisan structure. The Torre Nueva cannot, however, be treated as a builder's freak. If there is a departure of nine feet from a perpendicular line it is owing to the sinking of the foundations. Cases of settlement are generally chronic, and there can be no doubt of the symptoms which are to be observed in the tower. It menaces the people who are so proud of its renown. Although it was restored thirty years since, the ground could not be made firm, and owing to the subsidences, the tower was never in a worse state than it is now. The commissioners who have charge of the ancient buildings in Aragon have met and considered the reports of the architects, which state that it is no longer feasible to make the tower secure, and that the safety of the public makes demolition inevitable. But the commissioners, says *The Architect*, have affection for the tower, and, instead of approving of the operation, they have implored the advice of the Academy of St. Ferdinand, in Madrid. But a Spanish savant needs a long period of time for deliberation, and unless an accident should occur, the tower may be visible for many months or years. The faith of the custodians in its stability continues unchanged, for they allow people to ascend to the upper platform.

— According to official statistics published in the *British Medical Journal* the total number of medical men in Austria at the end of 1889 was 7,146, of whom 5,358 were doctors of medicine and 1,788 practitioners of a lower grade (*Wundärzte*, surgeons). The proportion of doctors to population was highest in the district of Trieste, where it was 61.7 per 100,000, Lower Austria being second with a very slightly lower ratio, and the Tyrol and Vorarlberg coming next at no great distance. In the other provinces the proportion was much smaller, being about thirty per 100,000 in Salzburg and Steiermark, and falling as low as 5.9 in Krain, 3.7 in Bukowina, and 3.2 in Galicia. As might be expected, the doctors of medicine most do congregate in the large towns, while the lower-grade practitioners most affect the villages and rural districts. About twenty-one per cent of the doctors of medicine practise in Vienna.

— The "Dea Febris" was invoked in the City of the Seven Hills to avert the local fever, and, in later times, a special saint is worshipped by the devout to save them from death by apoplexy. Statistics might be adduced, says *Lancet*, to show that apoplectic seizure — or, at any rate, cerebral hemorrhage — is exceptionally frequent as a "mode of dying" in Rome, the heavy atmosphere, charged (in the Campagna particularly) with malaria, and the remarkable stillness of the air, due to absence of winds, being eminently favorable to "determination of blood to the head." The saint whose intercession is implored by subjects of an "apoplectic habit," hereditary or acquired, is, curiously enough, St. Andrew. Now, as that apostle was, according to ecclesiastical tradition, crucified head downward, at his own request (as he deemed himself unworthy to win the martyr's crown in the position in which his Divine Master died on the cross), we can readily understand how he should have been selected by the faithful as the typical example of death by congestion or stasis of the cerebral circulation, and how in the saintly calendar he should be especially invoked to protect his votaries from dying by a similar cause.

— A meeting of Ohio scientists, for the purpose of organizing a State Academy of Science, will be held at Columbus, Dec. 31. The question of an Ohio Academy of Science is not a new one; it has been often broached, but, until now, no decisive step taken. In several other States such societies have been in successful operation for many years. At the annual or semi-annual gatherings of these organizations the scientists of a whole State read and discuss papers embodying the results of work in their respective fields or on methods of research or of instruction, thereby greatly aiding and strengthening one another, as well as materially advancing the cause of science and sound knowledge; moreover, experience proves that no better means has been devised for friendly and social reunion of those engaged in kindred activities. All those of the opinion that the organization of an academy of the kind proposed can be effected and maintained by the scientists of Ohio, and in a manner that will make it profitable to its members and an honor to the State, are invited to participate in its organization at a meeting called at Columbus, Dec. 31, at 2 P.M., in the High School Building. The committee issuing the call was appointed for the purpose by the Biological Club of the Ohio State University and Agricultural Experiment Station, and has secured the promise of hearty co-operation from a goodly number who are expected to be present, read papers, and otherwise aid at this first meeting. A partial list of papers to be read is as follows: Biological Investigation of Waters, by A. M. Bleile; Notes on Lichens, by E. E. Bogue; Dollen's Method for the Determination of Time, by R. D. Bohannan; Photography in Scientific Work, by J. N. Bradford; Some Notes on the Fauna of the Wabash and White Water Valleys, by A. W. Butler; Biological Training as Preliminary to the Study of Medicine, by H. E. Chapin; Observations on *Empusa aphidis*, by Freda Detmers; Protective Inoculation, by H. J. Detmers; The Babcock Milk Tester, by F. G. Fallenbach; Mycological Notes for 1891, by W. A. Kellerman; Seed Germination at Intervals after Treatment with Fungicides, by W. A. Kellerman; Notes on the *Ægeridæ* of Columbus, by D. S. Kellicott; The Effect of Moisture upon the Vitality of Seed, by William R. Lazenby; Notes on Cross-Fertilization, by William R. Lezenby; Comparison of Evaporative Powers of Certain Coals with their Ultimate Composition, by N. W. Lord; A Study of Plant Introduction in Franklin County, by A. D. Selby; The Coal Supply of the World, by H. P. Smith; Science for the Blind, by Henry Snyder; Some Laboratory Fixtures, by Henry Snyder; Some Features of Ohio's Mollusca, by H. A. Surface; Magnetic Fields in Laboratories, by B. F. Thomas; On the Behavior of Antiseptics toward Salivary Digestion, by H. A. Weber; The Relation between the Increase of some Insects and the Overflow of Rivers, by F. M. Webster; Notes on the Fecundity of some Species of Aphides, by F. M. Webster; Variations and Intermediate Forms of certain Asters, by W. C. Werner; Post-Glacial History of Black River, by A. A. Wright.

— Dr. M. A. Veeder, Lyons, N.Y., has issued a circular, urging observations of auroras, and a blank for entering the records, which may be obtained from him. Dr. Veeder says: "In order to determine the local distribution and altitude of the aurora, it is desirable to have numerous observers suitably distributed throughout the area covered by the observations so as to secure as full information as possible as to the extent to which an aurora was present or absent during each hour. In case that an aurora is not reported from any given locality, it is necessary to have the means of determining whether this failure was due to lack of observation, or to cloudiness, etc., or whether the aurora was really absent. For this reason it is desirable that there be as few blanks as possible in the table, although even the most fragmentary record may become of importance for purposes of comparison with others. The results already obtained warrant the belief that by concerted effort information of practical value may be secured. During the coming year auroras will probably increase in frequency, especially near the equinoxes, and a single display having well defined characteristics, like that from Sept. 8 to 11, 1891, may, if thoroughly observed, lead to most important conclusions."

— The Meteorological Department of the Government of India has published Part IV. of "Cyclone Memoirs," being an inquiry into the nature and course of storms in the Arabian Sea, and a catalogue and brief history of all recorded cyclones in that sea from 1648 to 1889. The work, says *Nature*, which has been prepared by Mr. W. L. Dallas, chiefly for the use of mariners navigating those parts, will no doubt be of considerable use to them, as hitherto there were no track charts of the storms in the Arabian Sea for the different months. For the majority of the storms quoted the available materials are admittedly very scanty; nevertheless, the author has been able to draw some useful conclusions from them with reference to the general behavior of the storms. The paper is divided into two parts—the first gives the details of each of fifty four storms in chronological order, the second treats of their geographical distribution and movements according to months and seasons, and the discussion is followed by charts showing the tracks of the storms in the different months. The cyclones are formed on the northern limits of the southwest monsoon; when the northern limits of the monsoon reach the land, and also when the northeast monsoon extends from Asia to the equator, which is the case from December to March, no cyclones are formed over the Arabian Sea. The barometric fall is gradual and equal on all sides, except near the centre, and a depression of 0.25 inch below the average is indicative of the existence of a cyclone in the neighborhood. When the storms are in confined waters they may burst with great suddenness, but in other cases strong winds are felt for several hundred miles around the centre. The northern parts of the Arabian Sea are liable, during the prevalence of the northeast monsoon, to be disturbed by small cyclonic storms descending from the highlands of Persia and Beluchistan, but the whole of the southwest of the Arabian Sea, though liable to southwest gales during the summer monsoon, and to strong northeast winds during the winter monsoon, is free from cyclones.

— The Iowa Academy of Sciences will convene in Des Moines, Iowa, December 29, 30. A full attendance and a complete programme is announced. The president of the academy is Professor C. C. Nutting, of the State University; Professor Herbert Osborn, of the State Agricultural College, is the secretary.

— An Austrian expedition for the scientific exploration of the Mediterranean found on July 28 last, between Malta and Crete, in 35° 44′ 20″ north latitude, and 21° 44′ 50″ east longitude, a depth of 14,436 feet, the deepest sounding yet taken in the Mediterranean. At 22½ miles south-east a sounding of 13,148 feet was taken.

— Dr. E. Von Drygalski, at a meeting of the Geographical Society, October 10, spoke upon his expedition to Greenland in the summer of 1891, according to the "Proceedings of the Royal Geographical Society." The inland-ice and glaciers of Greenland present the nearest comparison to the conditions which must be supposed to have prevailed in the most recent geological time over the greater part of Germany, when the Scandinavian glaciers extended as far as the Hartz and Riesengebirge. If one desires to investigate more closely the circumstances under which the movement of such enormous ice-masses took place, one must, in order to a successful inquiry into this subject, make one's studies not on the small glaciers of the Alps, but on the glaciers of Greenland, which stand in direct connection with the great ice-covering (130,000 square miles) of the interior and in their movement, which reaches a velocity, unheard of in the Alps, of 35, 70, and even 100 feet a day, are indicative of the force of the inland ice itself. The principal task of the expedition was to investigate the conditions of movement of the ice-masses of Greenland and their main physical features for one year. But because it was impossible to transport, during the present year, in the vessels of the "Greenland trade" which from Copenhagen carry on the commerce with the colony, the complete equipment necessary for wintering in the polar regions, and inasmuch as it appeared desirable to first of all come to a decision on the spot as to the point at which a station should be established, it was decided to despatch a preliminary expedition for this purpose in the summer of 1891. This expedition sailed from Copenhagen on the 3d of May, and on the 16th of June reached Jacobshavn. The intention was to travel from here across the ice-fjord to Claushavn, and then to reach, viâ Tasnisk, the great Jacobshavn glacier. But this proved to be impracticable, because all the fjords were choked full of ice. An attempt had therefore to be made to reach the glacier overland from the north. From the visit to the glacier it was ascertained that the edge of the glacier had not shifted to any considerable extent since Hammer's measurements in September, 1879. On the 20th of June the expedition set out from Jacobshavn, and proceeded by way of Ritenbenk through the Vaigat to the Umanak fjord, and arrived at Umanak on the 29th of June. From this point the party made their way to the little settlement of Ikerasak, situated in the interior of the fjord, whence different excursions were undertaken to the Sermilik, the Karajaks and the Itiodlilarsuk fjords almost up to the limit of the inland ice. The Store Karajaks Isbræ was determined upon as the best place for the station to be erected in the year 1892. On the 29th of July the return journey from Umanak was commenced, and on the 18th of September Copenhagen was reached.

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THE JAPANESE EARTHQUAKE.

On the 22d of October I left Japan, and on arrival in Victoria, B.C., found that six days later there had occurred the most disastrous earthquake of recent years. Previous to my departure shocks had been increasing in frequency, and several severe ones had been reported from the southern provinces. A sharp shock was felt in Yokohama about 6.30 of the 22d, which perceptibly swayed my brother's house, and caused things therein to move and rattle freely, the tremors lasting two or three seconds. During the summer I had made the ascent of Fuji, Asama, and other mountains, and had visited all the places of importance along the Inland Sea. I spent several days in Kobe, Osaka, Kioto, Nara, Nagoya, etc., and in other districts which have suffered so severely from the earthquake of the 28th of October. At this time there were no signs of the impending destruction. By the last mail I received from my brother papers up to the 18th of November containing very interesting accounts of the disasters and phenomena at the various places. Some details of the event have been already given in your columns, but a few additional items may not be without interest. In Yokohama the damage was inconsiderable and confined chiefly to chimneys and windows, with no loss of life or limb. The chimney of the Electric Light Works fell, and caused a stoppage of light. At Kobe a slight shock was felt at about 4 A.M., but this was only the precursor of the severer one which came at 6 h. 34 m. 35 s., and which lasted thirty-six seconds. A large number of chimneys were thrown down, crashing in many instances through the roofs, and buildings were badly twisted and strained. In some of the curio shops there was a large breakage of valuable goods. The centre of the disturbance was, however, more to the eastward, and the prefectures of Gifu and Aichi (in which is Nagoya) suffered most excessively. The great city of Osaka, second only in population to Tokio, sustained serious damage. The shock occurred at 6.39 A.M., and about twenty followed during the forenoon. Many lives were lost by the collapse of some of the spinning factories. The Naniwa mill, a brick three story building, had a span of 120 feet, and the walls, apparently not properly tied together, separated so as to allow the roof to fall in, and many of the employees were killed or wounded. In the foreign settlement (Kawaguchi) nearly all the houses lost their chimneys and suffered more or less damage otherwise. The bridge across the Yodagawa at this point was also broken by one of the piers sinking several feet. The veneral Bishop of Exeter and his son, Bishop Bickersteth of Japan, were guests of Venerable Archdeacon Warren and narrowly escaped injury from the chimney falling through the house. The arsenal and mint sustained loss through the distortion and breakage of chimneys, etc., but there appears to have been no loss of life in these more substantial buildings.

In the town of Gifu the destruction was widespread, and the number of killed and wounded very great, while fires broke out, which were not finally extinguished until the 30th, and added to the loss of property. The Tokaido Railway through this region suffered severely by the destruction of stations and bridges, and the loss has been stated at $500,000. All the villages along the line were disturbed, and some almost totally destroyed.

Nagoya, a fine city of nearly 200,000 inhabitants, received great injuries, and the loss of life and property was terrible there. The shock is reported to have occurred at 6.30 A.M., and 200 shocks to have been felt during the forenoon. All the brick buildings in the city except two, that of the Electric Light Company and the railway freight shed, were wrecked. The roof of the post-office fell in and four of the employees were killed, and the prison was destroyed and many of the inmates killed or wounded. An early morning service was being held in the Methodist chapel, and four of the native Christians were killed, and Mr. and Mrs. Van Dyke and several natives badly wounded. The embankments of the Kiso River were broken, and several villages were swept away and many people drowned by the escaping flood.

The foregoing are but a few of the details of this fearful catastrophe; the mere list of the places which suffered (Shizuoka, Hamamatsu, and other important towns included) would alone take up too much space. At Nagoya the vertical movement is said to have been eight and a half inches, and an Osaka correspondent describes the houses as literally dancing, and the trees swaying to and fro as if in a gale. Mount Asama (only smoking heavily when I was on it in September) was started into greater activity and was sending forth flames and ashes, and Mount Ibuki (between Gifu and Lake Biwa) was also in eruption. The sea is said to have been violently disturbed in various places, even far from land, and the captain of the "China," which left Hongkong on the 31st of October, reported in Yokohama: "Nov. 3, at 6 45 P.M., passed Suwusima twelve miles off. The volcano on the island was in eruption, shooting flames to the height of about 800 feet, at intervals of about thirty seconds."

Shocks continued at frequent intervals for several days after the first destructive one, but were diminishing in number and strength. The following are the latest figures for the prefectures of Aichi, Gifu, Fukui, and Mikawa, the most of the loss having been suffered by the two first named: Killed, 7,260; injured, 11,716; buildings (temples, dwellings, warehouses, etc.) destroyed, 111,566, and damaged, 53,683. The greatest loss of life appears to have been due to modern brick buildings and to the early hour, when people had not left their houses.

W. Hague Harrington.

PHYSIOLOGY OF GASTRIC DIGESTION.

THE foundations of our knowledge of the physiology of gastric digestion were undoubtedly laid by the careful study of the historical case of gastric fistula by Dr. Beaumont — the case of Alexis St. Martin. Animal experimentation and the test-tube reactions of the laboratory cannot be compared in accuracy to observations made directly upon the living human organism, when these rare opportunities arise which permit of such a study. Then, too, it may happen that a considerable rectification of current physiological doctrine has to be made, and the laboriously gathered results of many observers have to be replaced by those made upon a single case. Much depends, then, upon the skill and thoroughness with which the study of the processes in the human subject are undertaken.

It must be admitted that these qualities are conspicuous in the recently published records of a study of the chemical processes of the small intestine by Drs. McFadden, Nencki, and Sieber. The subject of their researches, says *Lancet*, was a female patient under the care of Professor Kocher, in whom an intestinal fistula had resulted from excision of a portion of gangrenous intestine due to strangulated hernia. The false anus was situated in the ileum just above the ileocæcal valve, so that the materials escaping thereby were wholly composed of the chyme which had passed through the whole length of the small intestine. For a period of nearly six months the woman lived under these conditions, permitting of a long series of observations relative to the time and character of intestinal digestion under varying forms of diet, etc. At the end of that time Professor Kocher re-established the natural channel by means of an operation which proved perfectly successful. It may be remarked at once that during the whole period when there was practically no large intestine the patient gained in weight, and, as the urinary analysis showed, eliminated a fairly normal quantity of urea.

The procedure consisted in adapting a flexible tube to the fistulous outlet, so as to collect all the material that escaped, and to note its characters under varying circumstances. In consistency this "chyme"— if it may be so termed — was more fluid and diarrhœal when the diet was albuminous than when it was mainly of a vegetable nature. It was seen that the flow of chyme from the small into the large intestine is steadily continuous, being least marked during the night, owing to no food being then taken; and by some ingenious experiments (e.g., the addition of hard beans to the food, or of salol, which allowed of the detection of salycylic acid in the matters escaping) it was shown that the passage of foods from mouth to cæcum occupies at the least two hours: but all traces of the substances introduced did not disappear for from nine to fourteen or even twenty-three hours. The rate of flow, of course, bears much relation to the consistency of the intestinal contents. As regards the nature and properties of the evacuated materials, it is noticeable that they were almost free from odor, containing hardly any products of albuminous disintegration, such as indol and sulphuretted hydrogen; they were slightly acid in reaction, tinged yellow by bilirubin, and, according to the predominance of flesh or starchy matter in the food, showed muscle fibre, albuminous granules, vegetable fibres, starch granules, etc., and invariably a large number of various forms of bacteria. The filtrate yielded albumen, mucin, peptone, dextrose, the two forms of lactic acid, acetic acid, and the biliary acids and bilirubin.

The authors enter very fully into the characters of the bacteria they find, many forms being special to the small intestine. others existing also in the mouth; but, passing over these, which would entail a full description to be intelligible, we may glance at the main results of their researches, which somewhat modify accepted physiological teachings. One point of interest is the fact that albumen is hardly, if at all, decomposed in the small intestine. Even the action of the tyrosin of the pancreatic juice is small, for leucin and tyrosin were not to be found. Probably, in health, albuminous disintegration takes place chiefly in the large intestine, and it is only in disease that it occurs in the stomach or small intestine. Amongst the products of such decomposition are iodol, skatol, phenol, sulphuretted hydrogen, carbonic acid, methylmercaptan, etc., all of which may be regained from the large intestine. The bacteria of the small intestine are concerned in the disintegration of the carbo-hydrates into lactic, acetic, and succinic acids, and also into ethylic alcohol. The authors, in noting this last-named fact, cannot avoid a thrust at the total abstainers. It is generally believed that the chyme is rendered alkaline by the secretien of the small intestine, but they find that, owing probably to the reinforcement of gastric acidity by the organic acid resulting from sugar, the total quantity of acid is more than can be neutralized by the bile, pancreatic, and intestinal juices. If, however, the alkalinity of these fluids be diminished, the intestinal contents are hyper-acid, and mucin is precipitated instead of being intermingled with the chyme. This explained the diarrhœal quality of the evacuations noted to be associated with a large amount of sugar and organic acid in the chyme. On the other hand, an excess of alkalinity favors putrefactive decomposition, the acids apparently holding in check the bacteria concerned in albuminous disintegration. A marked contrast in this respect was exhibited between the small and large intestine. Putrefactive bacteria could hardly be at all isolated from the former, whilst they abounded in the latter; but this is not owing to the influence of bile, which Nencki showed to have no real antiseptic property.

The part played by bacteria in intestinal digestion is limited probably to the fermentation of sugar and carbo hydrates generally, the excess of acid resulting from this fermentation being neutralized by the alkaline intestinal juice. But, much as bacterial life abounds in the intestinal canals, varying according to the kind and quality of the ingesta, it does not appear that the processes initiated by these organisms are of such value or importance in nutrition as the chemical ferments. Certainly the patient who was the subject of these observations gained in flesh, although for six months she was deprived of all the bacterial processes that go on in the large intestine.

OCEAN CURRENTS AND TEMPERATURES IN EAST ASIATIC WATERS.

UNDER this title Dr. Gerhard Schott contributes to a recent number (ix.) of *Petermann's Mitteilungen* an interesting paper, which contains new information regarding the course of the Kuro-Shiwo and other currents in Chinese waters, and also as to ocean temperatures. The conclusions arrived at by the author are based upon researches made by him among the archives — principally ships' journals — of the German Admiralty, which contain observations of great value to science. With regard to the Kuro-Shiwo, the general result of Dr. Schott's researches, says the Proceedings of the Royal Geographical Society, is that this great ocean current is not so extensive as hitherto supposed. Throughout the whole of the year the warm stream is confined as a constant current exclusively to the west side of the line of islands, Meiaco shima, Lu-Chu, and Linschoten, while the sea to the east, although showing at times displacements to the north-east, is otherwise quite motionless. The supposed constant current of considerable velocity just east of the Lu-Chu Islands does not exist. The Kuro-Shiwo, in the northern part of its course, shows more tendency to break through the island barrier to the east. Its principal outlets in this direction are the Colnet Straits (30° north latitude) and the Van Diemen Straits (31° north latitude). From this point to the meridian of the Kii Channel the current reaches its greatest extent, and flows pretty close to the land in a north-east direction, with a striking bend, under 135° east longitude, to the south-east, resuming as it flows at some distance from the coast up to Yokohama its old north-east direction.

Under the 38th parallel east of Cape Kinkuasan, the Kuro-Shiwo strikes the Oga-Shiwo, i.e., the cold Kurile current from the north. The observations of ships in this region show that often in a few hours the temperature of the water falls 20° and 30°, and the temperature of the air also; the weather becomes cold, muggy, and rainy, and the color of the water changes from the blue or blue-black of the tropics to the well-known bottle-green. The boundary line between the Kuro-Shiwo and the Oga-Shiwo, from February to April inclusive, is under 38° latitude and 143° to 145° longitude; in May, under 42° and 147°; in July, under 45° and 150°; and in August, lies north of 50° latitude. The polar current here does not extend at any time below 38°. The analogy between the Pacific and Atlantic in this respect is almost complete. The Oga-Shiwo is the Pacific Labrador current, and Cape Kinkuasan plays the part of Cape Race, except that the latter lies 10° further north than Cape Kinkuasan. After meeting the polar stream, the Kuro-Shiwo turns east, but Dr. Schott does not follow it in its further course. Running parallel and to the east of the Kuro-Shiwo is a second though less important warm stream, called the Bonin current, which comes from the south and flows in a north, north-east, and then east-north-east direction. At 130° east longitude it flows east in a course which former maps showed as the course of the Kuro-Shiwo. The Bonin current does not always flow to the west of the Bonin Islands; its mean axis of movement varies with the season of the year, and at the end of summer lies to the east of the Bonin Islands. In this case also there is an analogy with the phenomena of the North Atlantic, as Krümmel's investigations have showed that east of the Antilles and of the Florida current there flows a broad though not intensive stream in a similar direction. Dr. Schott discusses the influence of the winds upon these currents, and gives some important information with regard to currents in the Straits of Formosa and the Yellow and Japan seas. The second part of his article is devoted to water temperatures in these regions.

THE BOURBONS AND ARCHÆOLOGICAL REMAINS.

It would nuturally have been thought that the Restoration would have made it a special care to restore and preserve the monuments of the past, but it is a remarkable fact that this epoch was the commencement of a system of almost limitless destruction of the edifices which the Revolution had spared, and that the change of dynasty in 1830 has certainly been productive of benefit in this respect at least. In the time of Napoleon the Minister of the Interior, by his circular of June 4, 1810, proposed a long series of interrogatories to all the prefects relative to the actual condition of the old castles and abbeys in their respective departments. These documents are replete with curious and interesting facts. Under the Restoration, M. Simeon, when Minister of the Interior, adopted a similar measure, but it does not appear that any practical results were obtained. The lamentable system of indifference which prevailed on this subject up to 1830, says a writer in *The Architect*, may be inferred from the terms of that ordinance which can never be sufficiently regretted, by which the splendid depôt of historical monuments formed at the Petits Augustins was destroyed and dispersed under the pretext of making restitution to owners who no longer survived, or who did not know what use to make of the objects so restored to them. It is believed that not one of the monuments given back to individual owners has been preserved; and, notwithstanding the notorious difficulty of disposing of these splendid relics, a steady refusal was constantly returned to the reiterated requests of M. Lenoir, the founder of this unique museum, to re-establish his collection with what remained after restitution had been made to every known proprietor. This contempt for and unpardonable neglect of antiquity in a Government whose chief claim to respect was derived from the principle of antiquity, extended even to the Conservatoire de Musique; the curious collection of ancient instruments of music which had been formed there was ordered to be dispersed or sold at a low price. This ruinous system, which prevailed in Paris, was practised on a still more extensive scale in the provinces. It would scarcely be believed that, under a moral and religious government, the Corporation of Angers, which had for its chief a deputy of the extremest ultra-loyal opinions, should have been allowed to convert the Gothic Church of St. Peter into a theatre. It is still more incredible, but not the less true, that the Church of of St. Cesaire at Arles, which the most erudite antiquaries looked upon as one of the oldest in France, was transformed *en mauvais lieu*, without any public functionary protesting against such profanation. Who would think that no effort was made, when the Most Christian King returned to the throne of his fathers, to rescue the magnificent papal palace at Avignon from its military desecration? And who could credit the fact that at Clairvaux, in that celebrated sanctuary which was directly connected with the authority of the State, the exquisite church, so beautiful in its proportions and so complete in its grandeur, which dated from the twelfth century, and was said to equal Nôtre Dame, at Paris, in size, which was begun by St. Bernard, where so many queens, princes, and pious generations of monks were entombed, and where the heart of Isabella, the daughter of St. Louis, was deposited, that this edifice, which had survived the havoc of the Revolution, and the indifference of the Empire, should have been demolished in the very first year of the Bourbon restoration? It was then razed to the ground, with all its projecting chapels, without leaving one stone upon another, or even sparing St. Bernard's tomb, to make room for a square surrounded by trees in the centre of the prison which occupied the site of the venerable monastery. Before leaving Clairvaux, we may as well mention that a prefect of the department of Aube, under the Restoration, actually sold seven hundred pounds weight of the archives of this famous religious house, and which were removed to Troyes; and the Count de Montalembert stated that, when he was at that place, he walked over a heap of parchments strewed thickly on the floor, from which he picked up a bull of Pope Urban IV., the son of a shoemaker of that very city of Troyes, and probably one of its most illustrious children. The same prefect demolished the relics of the palace of the ancient counts of Champagne, of the noble and poetic dynasty of the Thiebauds and Henri-le-Large, because they were in the line of a crescent which his architectural genius had unfortunately devised. The beautiful gate of St. Jacques (constructed in the time of Francis I.) and that of Beffroy suffered the same fate. Another prefect of the Restoration, in the department of Eure and Loire, had no scruple in appropriating to his own use several painted windows of the Cathedral of Chartres to decorate the private chapel of his country mansion. It has been incontrovertibly proved that during the fifteen years of the Restoration more irremediable devastations were committed in France than in the period from 1789 to 1813. This destruction was certainly not enjoined by the Government, but it was done under its eyes, with its tolerance, and without exciting the slightest marks of its solicitude.

ANTIQUARIAN DISCOVERIES NEAR ALEXANDRIA.

In the London *Times* of Oct. 12 appeared a telegraphic announcement of the late interesting antiquarian discoveries at Abukir, distant thirteen and a half miles by rail eastward from Alexandria.

Excavations are being continued under the direction of Daninos Pasha, a savant well qualified for the work, to whom is due the merit of the discoveries; and if Government will supply the funds necessary to enable him to continue his researches, there are abundant indications that valuable "finds" will be made in a locality hitherto almost neglected by archæologists, and presenting much that is interesting, especially to students of the Græco-Roman period.

At four to six feet below the surface the diggers found three statues in rose granite, ten feet high, lying face downwards, among the ruins of a temple, of which part of the outer wall with lower portions of columns and several square yards of flooring have been laid bare. The statues had been originally erected at or within the temple, and one of them is lying in front of its pedestal, which is about three feet high. They represent in a group, according to the hieroglyphic inscription, Rameses II. (the Greek Sesostris) and his Queen Hentmara seated. The third statue is of Rameses II. in an upright posture, wearing a pleated tunic, bracelets, military crown, and a girdle bearing the inscription, "Beloved of Seth." At his left side he holds a sceptre, surmounted by the head of his son Menephtah (the Pharaoh of the Exodus), whose cartouch is inscribed on the sceptre. On the plinth at his back, which is of equal height with the statue, is chiselled a bas relief of Queen Hentmara in profile, wearing a pleated tunic and the royal tress. The inscription above her head is "Daughter of the King — beloved of her father — Royal spouse — great favorite Hentmara." On the back of the plinth is carved the royal banner of Rameses II, with all his known titles and appellations. The execution of the three statues is in the plain, vigorous style of the Twelfth Dynasty.

The feet of Rameses, which had been broken off in one piece with a clean fracture, were found at a few yards' distance. The two heads of the group have also been broken off, and are being searched for.

It is surmised that the temple and statues were overthrown after the edict of Theodosius, A D. 380, abolishing the Egyptian religion, but nothing has yet been discovered to identify the temple with any of those known to have existed during the Egyptian or Græco-Roman periods.

Dr. Nerutsos Bey's interpretation of the inscription is — Hentmara, daughter of the King, beloved of her father (i.e., the preceding King. Osiris Menephtah, who was father of both Rameses and Hentmara). royal spouse (of Rameses II.), the (referring also to Rameses) great favorite of Seth.

The Pharaohs, following the example of Osiris, King of the Gods, and his sister Isis, had the prerogative of espousing their own sisters, and this custom, consecrated by both the civil and religious law, was followed in several instances by the Ptolemies

Dr. Nerutsos, who is a well-known Egyptologist, has lately published a work entitled "L'Ancienne Alexandrie," embodying his researches, made during a long residence, and he is perhaps the greatest living authority upon the topography of the ancient city and neighborhood of Alexandria. Referring to the locality in which the above-mentioned antiquities were found, and which abounds with remains of old buildings, he recommends that explorers should seek to identify —

(1) The small Egyptian town Menuth, with its temple to Isis, and subterranean burial-places. Such a place has just been discovered by Daninos Pasha, in the solid rock, entered by a vertical shaft forty feet deep, and a sloping staircase of forty-five steps, terminating at the bottom of the shaft, where a series of galleries commence, extending in length to 170 feet.

(2) The Græco-Roman village Zephyrion, where stood a temple to Artemis Sotera, and numerous country villas.

(3) The headland Zephyrion, on the highest point of which was a temple to Venus Arsinoe, Protectress of Mariners.

(4) The Byzantine monastery of St. Cyr, corrupted to Abba Kyr, whence the name of the present town of Abukir.

The monastery and neighboring buildings were destroyed by an earthquake, followed by a tidal wave, soon after the capture of Alexandria by the Arabs. More than a dozen sphinxes and ruins of massive buildings, submerged by that catastrophe and subsequently, are now plainly visible in the shallow waters of the bay.

The twenty-third annual meeting of the Ohio College Association will be held in Columbus, Dec. 28-30.

THE FAIRBANKS MUSEUM.

Tuesday evening, Dec. 15, was a holiday occasion for St. Johnsbury, Vt., for she was at that time the glad recipient of such a Christmas gift as rarely falls to the lot of a community — such a gift as will make her a leader among New England villages in the possession of peculiar educational advantages. Col. Franklin Fairbanks, in fulfilment of his long cherished desire, presented the Fairbanks Museum of Natural Science to the people of St. Johnsbury.

In his address Col. Fairbanks said: "This day, one of the happiest of my life, marks the completion of a plan long cherished; that of erecting a building suitable for the objects in natural science which I have been collecting from my boyhood.

"There is implanted in the breast of every intelligent being a desire for knowledge. Schools are established to develop that desire and expand it into larger fields, fitting us for usefulness in the world, and giving us pleasure and profit. Who has looked through a telescope at the stars, without wishing to know what there is in, or upon them, and desires to look again, hoping to discover something that is beyond? Who has used the microscope to examine the flower or the insect, which is invisible to the naked eye, without longing to know more of what this wonderful instrument alone can reveal? In so far as is possible, this thirst for knowledge should be gratified.

"Those of us who have not had the privilege of a liberal education (so-called) must make up for our loss by the study of objects and beings directly around us, using our eyes and our ears, which may become the windows of our minds, letting in a flood of light and knowledge.

"Life is so short and its limitations are so great, no person can know everything, but each may learn one thing, and learn it well. The child may not be able to calculate eclipses, or understand conic sections, or Greek roots, but he may begin early to learn of the life about him. For this, I have erected this building, and made accessible to you this fruitage of my own observations.

"The collection comprises illustrations in ethnology, ornithology, oology, entomology, zoology, conchology, botany, mineralogy, geology, and palæontology.

"At the laying of the corner-stone of the Museum on the 4th of July, 1890, I told the children that I commenced my collection when a small boy, gathering stones and minerals, because of their beauty. To illustrate, I hold in my hand a grouping of crystals, which I found on the Willey Slide in the White Mountain Notch, when I was about twelve years old. My father was taking me with him on a journey, and we stopped to see the slide which a few years before had buried the Willey family, and this stone attracted my attention, and to-day brings that visit vividly to mind.

"I have been a careful observer, going about with my eyes and ears open. Not a bird comes within my vision but I try to learn its name, its habits, and its uses, and its song if it has any. In the summer time this is a never-ending source of delight, and so I might mention butterflies, beetles, and all insect life; the flowers and ferns and many other objects of study which live and move in great profusion about us all the summer long.

"Now if this collection will create in you a desire to know the facts regarding the life which is around you, and which your eyes see and your fingers touch; in short, if you are thereby induced to study and investigate the things that are nearest you, my aim will be accomplished, and I trust through the aid you may receive in yonder building, you may make far greater progress than I can comprehend.

"A long time since, I asked our architect, Mr. Packard (by whose skill and taste our town has been greatly enriched), to devise some plan by which the collection could be opened for the public benefit, while remaining in my house, but that seemed impracticable, so I abandoned it.

"The building is now complete. It consists of a main hall, with a gallery, for cases and tables. On the first floor of the ell is a curator's office and a class-room. On the second floor and over the class-room and office is a well-ventilated lecture-room. All the rooms are thoroughly equipped for use. In the basement are the furnace for heating, and a large, well-lighted laboratory and taxidermist's room. The whole building is lighted with both gas and electricity. For a year and a half the curator, Miss Tyler, has been classifying and cataloguing the collection and preparing suitable labels, giving name and location of the specimen, together with a reference to some book where a fuller description can be found, thus making it, not what too many collections are, a dead affair, but really a thing of life, which shall help in your search for knowledge. I hope additions may be made, by those interested in these things, of such objects as shall be worthy and useful in aid of the work in hand. Should persons have in their possession any objects of merit, illustrative of natural science, which they do not care to donate, but would like to loan, they may be shown to the trustees, and, if approved, may find a lodgment in the museum and be marked "loaned," to receive the same care as is bestowed upon the rest of the collection.

"It is my expectation that studies in the natural sciences will be introduced into our public common schools in all grades, from the primary to the senior, and that arrangements may be made between the prudential committees of the schools, the faculty of the academy, and the trustees and managers of the museum, for classes to be held in the class-room of the museum at such times as are best. Objects from the collection may thus be used by way of illustration under suitable and proper regulations. In this way the museum will truly become a factor in the education of our children and young people.

"It is my desire that its usefulness may not be restricted to the public schools or academy of this town, but that it may be open to the inspection and use of any school or class in the county or State. It is my desire that this institution shall take its place with other public institutions, as an educator for the young, lifting all who shall avail themselves of its advantages to a higher and larger knowledge concerning the things of God's creation, which lie all about us, now, practically, for many, a sealed book.

"It is my desire that the museum shall be opened free to all at such times as the trustees may direct, and that the public observe such rules and regulations as seem necessary and wise to be made.

"I cannot let this opportunity pass without grateful mention of the very valuable aid rendered, and advice given, by her who is the sharer of my joys and sorrows, the companion of my home. For years we have worked together in making this collection and in planning for this building, and to her I feel that much of its success is due.

"And it gives me pleasure to say that there is no debt upon the building or land, and that the institution is endowed, with an amount sufficient to maintain it for all time, if the funds are properly invested and the income judiciously expended"

BOOK-REVIEWS.

Fossil Botany, being an Introduction to Palæophytology from the Standpoint of the Botanist. By H. GRAF ZU SOLMS-LAUBACH, Professor in the University of Göttingen. Authorized English Translation by Henry E. F. Garnsey, M.A., Fellow of Magdalen College, Oxford. Revised by Isaac Bayley Balfour, M.A., M.D., F.R.S. New York, Macmillan. 8°.

THE superb English edition of Count Solms-Laubach's "Einleitung in die Paläophytologie" which the Clarendon Press has recently brought out is now in the hands of paleontologists and botanists. The original German edition, which appeared in 1887, was briefly noticed by the present writer in the *American Journal of Science* for July, 1888 (p. 72), after a careful reading, and the impression which such a reading produced was then recorded. The daily use of the work since that time as a laboratory textbook has somewhat modified that impression, and an English translation of it is, to say the least, a very welcome accession.

The attempt has been several times made to reduce the science of fossil plants to a form adapted to general use. There is no science which is less accessible to the student from the scattered and fragmentary character of its literature, and every effort to collect this and present it in compact form should be thankfully received. Among other works that have claimed to do this should be mentioned the Marquis Saporta's "Monde des plantes avant l'apparition de l'homme" (1879), the late Dr. Schenk's "Fossilen Pflanzenreste" (1888), and Sir William Dawson's "Geological History of Plants" (1888). Of these the first-named realizes much more nearly than any of the others this claim, being popular in its treatment and covering the entire field, both geologically and botanically. The second is a condensation or abridgment of the elaborate treatise on the general subject in Zittel's "Handbuch der Paläontologie," begun by Schimper and finished by Schenk. But the abridgment is carried too far and the mode of presentation can scarcely be called popular. Sir William Dawson's work avoids these defects, but has the more serious one of both geological and botanical incompleteness, making it little more than a popular account of the paleozoic flora of Canada. The present work is open to a similar criticism, as it confessedly takes no account of anything later than the mesozoic, and has nothing to say about the geological history of the type of vegetation now dominant on the globe, viz., the dicotyledons, which, nevertheless, are known to have flourished in earliest cretaceous times, and which of all fossil plants may, at the present time, at least in America, be said to be the most interesting from the botanical, and the most important from the geological point of view.

The merits of this work, therefore, consist neither in its popularity nor in its generality. In what, then, do they consist? To what class is the work useful, and how can it be used? The treatment of the several forms of extinct vegetation which the author has selected is too thorough, minute, and technical for the non-botanical reader to follow. It is of little use to the geologist because, as stated on the title-page, it proceeds from the botanical standpoint. Botanists proper, who ought to profit most by it, are not likely to do so on account of the lamentable divorce of botany from paleobotany, as though fossil plants were not plants, and as such as worthy of study as living ones. If this work succeeds in dispelling to some extent this illusion it will certainly be useful. But dealing wholly with the lower forms, and largely with their internal and minute structures, so greatly neglected by botanists, it is not likely to accomplish this to any great extent.

It is, then, the paleobotanical student who, if any one, is to use this work. If he wishes to cover the whole field he usually has access to most of the literature of the subject, and is already familiar with the sources from which most of the work is compiled. If he wishes to make a systematic review of this literature he naturally goes to Schimper's "Traité de Paléontologie Végétale," and Zittel's "Handbuch der Paläontologie," Abtheilung II., where Schimper, and after his death Schenk, have admirably condensed it, but still have left it much more full than here. If he wishes to acquaint himself with the original investigations thus summarized, he goes to Williamson, Renault, Grand'Eury, Zeiller, Weiss, Saporta, and the rest, who have furnished the facts. In so far as Count Solms has himself contributed in this work to these original investigations, a not inconsiderable part of it, it is useful to this class of students. But unquestionably the most important service which he has here done has been to put on record the matured judgment of a structural botanist of the first rank respecting the probable nature and significance of the many problematical extinct forms of vegetable life that have been found in ancient strata. Whenever one of these problems arises the first question the paleobotanist now asks is, What does Solms-Laubach say? It is true that he entirely omits many such forms, that he frequently contents himself with stating the opinion of others, and that quite as often he declares that the facts do not warrant an opinion. But on many points his mind is made up, and it must be said to his credit that he has not attached himself to any particular school, but appears to be guided entirely by the evidence as he understands it.

It is a great comfort, for example, to know that he regards the Cordaiteæ as gymnosperms without asserting that they are conifers; that he does not accept the views of some French paleobotanists that the secondary or exogenous growth in Sigillaria, Stigmaria, and Calamodendron necessarily relegate these forms to the phanerogams; that he considers Stigmaria as the roots of Sigillaria, Lepidodendron, etc., and does not admit the two kinds of Stigmaria maintained by Renault; that he opposes the view of Renault that Sphenophyllum is related to Salvinia, and while regarding the group as *sui generis* and incapable of being brought within any classification of living plants, inclines to see its nearest affinities in the Lycopodiaceæ; that of all the different views that have been held as to the affinities of Spirangium he regards that of Nathorst as the most attractive, viz., that it may represent the gigantic sporangia of Chara surrounded by spirally twisted envelope-tubes; and that he leans to the conclusion that Williamsonia belongs to the Cycadaceæ, or to some analogous type of vegetation.

The most serious charge that must be made against this English edition is that it has not been revised to date. No science is progressing more rapidly than paleophytology, and the department that is advancing the fastest is our knowledge of just such problematical forms as those considered in this work. In making a translation it would have been easy to introduce the result of the investigations of the last four years, and the value of these results would have been very great to the class who are certain to make the most use of the work. But although it is said to be an authorized edition, it seems to be nothing more than an exact translation of the German edition of 1887.

For, example, nothing new is presented in relation to Bennettites, on which the author has been so long engaged. On page 97 the remark of the original edition that "the sketch here given of Bennettites, which I hope to make more complete at some future time," etc., is repeated without modification. But the "future time" came more than a year ago, and the Count's able researches on this form were published in the *Botanische Zeitung* for 1890 and noticed by the present writer in the *American Journal of Science* for April, 1891, p. 331. Still later the interesting specimen from Golden, Col., which Lesquereux called *Zamiostrobus mirabilis*, has been sent to him, and he has made sections of it and referred it to the same genus, which he now properly calls by Buckland's earlier name, Cycadeoidea. All this new matter should have been incorporated in the English edition.

We are never sure that we have the author's present opinion on the most problematical forms. Nothing is said of the recent discoveries of Zeiller, Saporta, and others respecting Spirangium and Fayolia, from which these authors are now disposed to give them over entirely to the zoologists as probably of animal origin. We should be glad to know what the successor of De Bary thinks of this. And it is amusing to read on page 371, where Williamsonia is under discussion and the early views of Saporta and Marion are considered, to learn that "it is hoped that a publication yet to come from Saporta will contain further and more convincing particulars on this subject." Paleobotanists have been familiar for at least three years with the "publication" referred to, as it appears in the "Paléontologie française, Plantes jurassiques," Livraisons 36–39, pp. 87–191, where the subject has received the most exhaustive treatment yet given to it, illustrated by seventeen plates. What we want to know is whether the professor of botany at the University of Strasburg agrees with the conclusion of the Marquis Saporta that the Williamsonias, without being precisely Pandaneæ, may have had a genetic relationship with that family (op. cit., p. 117). Solms Laubach's own conclusion, quoted above is given without the knowledge of Saporta's work, which might have modified it. It is also given without acquaintance with the important discovery by Nathorst of the inflorescence of *Williamsonia augustifolia* attached to the stems and foliage of *Anomozamites minor*, a supposed cycadean plant,[1] and, although this is confirmatory of the views above expressed, it would be interesting to know to what extent he regards it as conclusive; and, in general it would be very useful to know what this author's attitude now is toward Saporta's views as here expressed (op. cit, pp. 229–236), according to which not only Williamsonia, Weltrichia, and Goniolina, but Cycadeoidea, Anomozamites, and other forms hitherto uniformly referred to the Cycadaceæ, are taken entirely out of the Gymnosperms and assimilated to the angiospermous orders Balanophoreæ and Pandaneæ, and are grouped under his new and extinct class of Proangiosperms.

The *Sphenoglossum quadrifoliatum* of Emmons,[2] twice mentioned,[3] was carefully considered in 1883 by Professor Fontaine, and referred doubtfully to Actinopteris, a genus of ferns, in a work with which the author should have been acquainted,[4] and in treating the Cycadaceæ in this volume, as well as in his later studies of the Portland Cycadeoideæ, he seems to be equally unfamiliar with the important cycadean trunks discovered by Tyson in 1860 in the iron ore beds of the Potomac formation of Maryland, and described also by Professor Fontaine in his great monograph of the flora of that formation.[5]

The "forty-nine illustrations" so prominently mentioned on the title-page as a high recommendation are indeed excellent and largely the author's own, but in view of the uses to which this work is likely to be put, as explained above, this number is obviously far too small. To have secured the maximum usefulness, even to the small class to whom it is adapted, several times that number would have been required.

The English publishers have left nothing undone to render the volume handsome and attractive, and as usual, where the publisher's point of view is alone followed, the convenience of the reader and user is often sacrificed to style and appearance. This is notably the case, and applies to the German edition as well, in the avoidance of italics. It may be admitted that the printing of all words having the Latin form in italics produces, in works of this class, a very unseemly effect, but the compromise which limits them to strict binomials, i.e., cases in which the species requires to be mentioned, reduces this evil from the esthetic point of view to a degree which is many times counterbalanced by the increased value which it gives to a work that is to be in constant use by busy students, who in nine cases out of ten are looking for some particular name. To compel this class to pore over a whole page for what, if italicized, would instantly catch the eye, is a positive cruelty to a deserving animal, and should be prohibited by penal enactment.

The placing of the references to the appendix to the literature in foot-notes at the bottom of the pages is a decided improvement from all points of view over the unsightly microscopic superior figures in the German edition, and perhaps in a work like this, where the same memoirs are frequently several times referred to, this general plan is upon the whole justifiable, but after all nothing is so simple, easy, and clear as the old way, in which the reader finds all he wants in foot-notes on the page he is reading, and this simplicity, ease, and clearness usually atone for considerable repetition as well as for whatever offence these foot-notes may give to the most fastidious eye.

If, from all that has been said, it should appear to any that the work before us consists entirely of a bundle of defects, let him hasten to divest himself of so false an impression. It is rather our purpose to point out these defects than to extol its excellencies, and should the latter be attempted it would require much more space than has been needed for the former task.

LESTER F. WARD.

AMONG THE PUBLISHERS.

THE Century Company is about to publish, in cheap tract form, the editorials on "Cheap Money Experiments" which have been appearing in *The Century*

— Houghton, Mifflin & Co. will issue early next year John Fiske's work on "The Discovery of America." It has involved a vast amount of research, and Mr. Fiske is reported to regard these two volumes as his most important contribution to American history.

— In "The Platform: Its Rise and Progress," Mr. Henry Jephson, private secretary to Mr. Forster and Sir G. Trevelyan, beginning with the days when an open meeting for discussion of public affairs was condemned as scarcely less than overt treason, traces the slow growth of political speech-making and analyzes the ele-

[1] Ofversigt af Kongl. Vetenskaps-Akademiens Förhandlingar, June, 1888. No. 6.

[2] "American Geology," Vol. VI., p. 134, pl. v., fig. 2.

[3] Ibid, pp. 182 and 315

[4] "Contributions to the Knowledge of the Older Mesozoic Flora of Virginia." By William Morris Fontaine. Monographs of the U. S. Geological Survey, Vol. VI., Washington, 1883, p. 120.

[5] "The Potomac or Younger Mesozoic Flora." By William Morris Fontaine. Monographs of the U. S. Geological Survey, Vol. XV., Washington, 1889. Text, pp. 186–193; Atlas, pl. clxxiv–clxxx.

ments in its development. The open-air meetings of the Wesleyan revivalists had their share; the old right of petition to the crown for redress of any grievance, and the occasional waves of popular clamor gave it a fitful existence until, at the time of the so called "Wilkes Rebellion," it first became an organized political engine, then and since acting as a perpetual check upon the party in power. To the student of politics this book should prove of great value and interest. It will be published by Macmillan & Co. early in January.

— Frederick Warne & Co., New York, will shortly issue at a popular price "Electricity up to Date for Light, Power, and Traction," clearly explained, with diagrams, etc., for non-scientific readers, by John B. Verity, M.Inst.E.E. (London). The same firm will shortly publish the new volume of "Barker's Facts and Figures for the Year 1892," edited by Thomas Whittaker, containing a large amount of information relating to commerce, government, insurance, agriculture, population, education, finance, health, wealth, religion, railways, etc., with special reference to those matters which concern the inhabitants of Great Britain.

— A "General Encyclopedia of the History and Science of the Jews" has been undertaken by J. Singer, in Paris, and will comprise twelve large volumes, according to *The New York Tribune.* The author hopes to present the main facts of Jewish history, and to show the effects of the Jewish race upon the various factors of civilization, science, literature, commerce, industry, etc. The work will not be finished for some time.

— The trustees of the British Museum, we learn from *The Publishers' Weekly*, will shortly issue the second instalment of Dr. Bezold's "Catalogue of the Cuneiform Tablets in the Kouyunjik Collection." This volume will contain the descriptions of nearly six thousand tablets and fragments which formed part of the famous clay library preserved by the kings of Assyria at Nineveh. This library was founded by Assurbanipal, B.C. 668–626, and contained official documents which had been sent to Sargon and Sennacherib by the generals of the army and others, as well as a series of works relating to every branch of science known to the Assyrians, and copies of ancient classical books and legends from Babylonia. In this volume will be found a classification of omen, and astrological texts; a work which has never before been attempted; and a considerable number of important extracts are printed in the cuneiform characters.

— Hubert Howe Bancroft, who is spending the winter with his family in the City of Mexico, has been requested by Gen. Porfirio Diaz, President of the Republic of Mexico, to write a book on the resources and development of Mexico, to be published in Spanish and in English, and to be a true and vivid representation of industrial Mexico as it exists to-day, primarily for presentation at the

CALENDAR OF SOCIETIES.

Chemical Society, Washington.

Dec. 10.—H. W. Wiley and W. H. Krug, On so called Floridite; T. M. Chatard, Notes on Analysis of Phosphate Rocks; I. T. Davis, Meat Preservatives; W. F. Hillebrand and Wm. H. Melville, On the Isomorphism and Composition of Thorium and Uranous Sulphates; a paper on Midzu Ame is proposed for the meeting of Jan. 14, 1892.

Biological Society, Washington.

Geo. Marx, On the Structure and Construction of the Geometric Spider Web; Chas. D. White, Some Peculiar Forms in an Upland Carboniferous Flora; F. H. Knowlton, Fruiting Ferns from the Laramie Group; Frederick V. Coville, Review of Kuntze's Revisio Generum Plantarum; C. W. Stiles, Notes on Parasites: *Spiroptera scutata.*

World's Fair. Mr. Bancroft went south, says *The Publisher's Weekly*, to avoid rather than to seek work. Having many warm friends in that quarter, he had hoped for a brief period of rest after many years of severe labor. But when Gen. Diaz made this request, offering at the same time not only to co-operate with him in every respect, to give him freely his own views on all important subjects, but to enlist the co-operation of the chiefs of departments and Governors of States, he felt that he could not refuse. Gen. Diaz had shown him many favors in times past; furthermore, the subject had peculiar attractions. He had been over the same ground historically, and was interested in its later development. As in all his publications, Mr. Bancroft will utilize the labors of able assistants, who have been at work in various parts of the republic collecting material. Besides these, Mr. George H. Morrison, Secretary of the History Company of San Francisco, will at once join Mr. Bancroft in Mexico, and assist in carrying forward this important undertaking.

— The geographical collection made by the Department of Geography of the Brooklyn Institute during the years 1889 and 1890, and very greatly increased in value and completeness, will be exhibited in the Natural History Building in Central Park, New York, at Fifth Avenue and Sixty-fourth Street, for six weeks, beginning on Dec. 24, at nine o'clock. The exhibition will occupy the two main floors of the building, and will be open free to the public from 9 A.M. to 6 P.M., on six days in the week, and until ten o'clock on Wednesday and Saturday evenings. The exhibition is given at this time in order to afford teachers, superintendents, and all others interested in education from all parts of the country, to visit and study the collection during the holidays, when the schools are not in session. The exhibition is made under the auspices of the New York Teachers' Association, which defrays all the incidental expenses. The Board of Park Commissioners of New York have generously contributed the use of the Museum Building.

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